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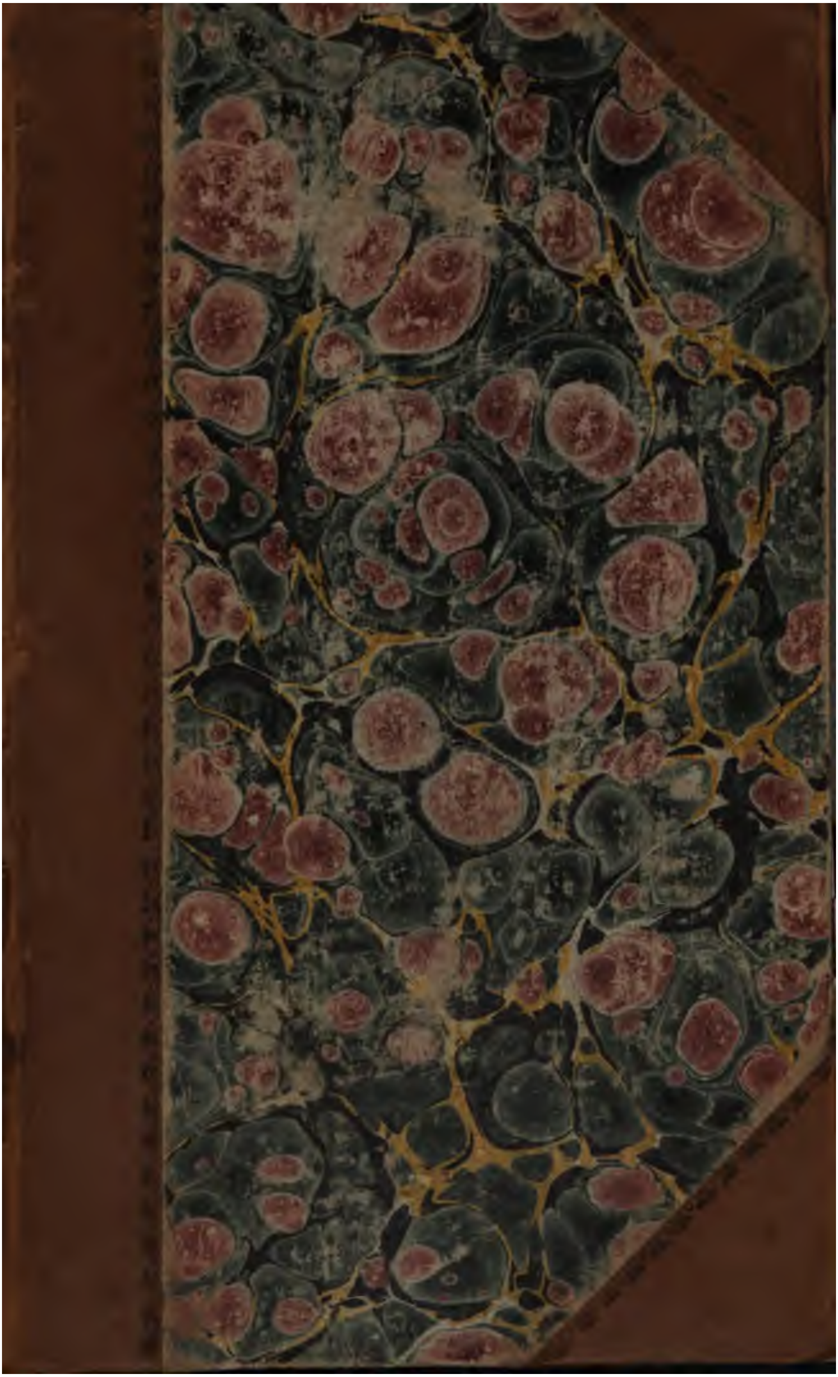

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NEW AND COMPLETE MANUAL

OF

AUSCULTATION AND PERCUSSION.

NEW AND COMPLETE
MANUAL OF AUSCULTATION
AND
PERCUSSION,

APPLIED TO

The Diagnoſis of Diſeaſes.

BY M. A. RACIBORSKI, M.D.

OF THE FACULTY OF PARIS, FORMERLY SURGEON IN THE POLISH ARMY,
PROFESSOR OF MEDICINE, KNIGHT OF THE ORDER OF THE
GOLDEN CROSS OF POLAND, ETC. ETC.

TRANSLATED BY

WILLIAM FITZHERBERT, B.A.
CAMBRIDGE.

LONDON:
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1835.

368.

LONDON:
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TO

M. BOUILLAUD,

Professor of Clinical Medicine at Paris, Knight of the Legion of Honour,
Member of the Royal Academy of Medicine, Of the Phrenological Society,
Of the Medical Society of Emulation, etc. etc.

IN TESTIMONY OF MY LIVELY GRATITUDE,

RACIBORSKI, D.M.P.

TO

JOHN ELLIOTSON, M.D. CANTAB., F.R.S.

President of the Phrenological Society in London,
and of the Royal Medical Society in Edinburgh; Professor of the Principles and Practice
of Medicine, and of Clinical Medicine, and Dean of the Faculty in the
University of London; Senior Physician of the North London Hospital; Fellow of the
Royal College of Physicians,
and formerly Physician to St. Thomas's Hospital, &c. &c.

THIS MANUAL

IS INSCRIBED, AS A TRIBUTE OF RESPECT TO HIS

PROFESSIONAL TALENTS IN GENERAL,

AND

PARTICULARLY TO HIS ACCURATE AND SKILFUL EMPLOYMENT

OF

AUSCULTATION AND PERCUSSION,

BY THE TRANSLATOR,

AUGUST 3, 1835.

PREFACE OF THE TRANSLATOR.

The work of which a translation is now offered to the medical profession has strong claims on their attention.

The part of the work which relates to the heart cannot fail to excite considerable interest: it is taken in a great measure from an unpublished work of Professor Bouillaud, and is at once masterly and original.

The chief merits of the work are the new matter which it contains, and the method and clearness with which the Author has collected into it and arranged all that is yet known on auscultation and percussion.

An abundance of valuable matter, bearing on this branch of medical science, is to be found, here and there, detached and unconnected, in journals and periodicals, and in large works, such as the "Dictionnaire des Sciences Médicales;" the subject has also been ably handled in a variety of separate treatises.

But M. Raciborski is the first person who has collected together every thing of real importance, out of the mass which has been written on auscultation and percussion. Till the appearance of the present work the Manual of M. Collin was the best collection on the subject, but it contains scarcely any thing on the auscultation of the heart, its arrangement also is defective, and it is otherwise very incomplete. But so greatly was the want of such a book felt, that, notwithstanding its defects, it has been translated into several languages.

Independently of the new matter, the present Manual is decidedly superior, both in arrangement and execution, to any work on the subject which has hitherto appeared: it has been remarkably well received in Paris, and is there considered to be one of the most complete works on any scientific subject, which has appeared for a long time.

The Translator has himself studied under the author, of whose professional skill and accuracy of observation he is able to speak in the highest terms; he has spared no pains in rendering his translation as complete as possible, and has placed in notes, quite distinct from the translation, the few occasional remarks which he has thought it necessary to make.

There can be no doubt that a good and complete work on the subject of auscultation and percussion is much wanted in England; the Translator confidently believes, that the present Manual is calculated to supply the deficiency; and his most sanguine expectations will be realised, if his translation should be as favourably received and as highly appreciated by the profession in England, as the original has been on the continent.

Paris, July 1835.

PREFACE.

THE present publication is a *manual* on Auscultation and Percussion; that is, a portable book. All elementary books should be portable; not merely because the form is more convenient, but also because the domains of a science being once well determined and reduced within proper limits, those limits are always within bounds.

A good *manual*—by this is understood an elementary book—far from giving a vague and inexact idea of the science or branch of which it treats—ought to present the whole of its frame-work; traverse and set bounds to its domain in all directions; lay down fundamental facts, in order afterwards to deduce from them all such as are not primitive or irreducible; assign its syllogistic rank to each ring, primary or secondary, of the scientific chain, and present, in the exposition, a natural relationship of ideas, at once clear for the mind and advantageous to the memory. The good manual, without mutilating the frame-work, rejects, by a judicious analysis, all that does not essentially relate to its object; and the synthesis which it offers of all the facts simplified, but not mangled or disfigured, permits the proper colour of each analysed object to stand out in the common day-light which it reflects all around.

It is in works of this kind in particular that an author ought to dedicate his attention equally to views of generality and totality as to analysis and details. The relations of resemblance and difference serve as bonds of union to all the facts, and attach them to one another in the mind, where, but for this circumstance, they would be isolated and incoherent. General ideas afford the mensuration of a vast domain, of its large districts, its dependancies and environs; they are the marks which a traveller, recently arrived in a country, erects here and there to serve as his compass. They are indispensable in settling the locality of details.

To lay down the plan of a good elementary book would be to write the critique of almost all those which our science possesses. We do not remark this fault for the sake of boasting of having avoided it in a subject so limited as the present, and still less for the sake of proposing our work as a model for imitation. It is merely as a guarantee against the discredit merited by the majority of manuals. However, the present manual, were it deprived of the merit of execution, would still recommend itself by the choice of subject.

The importance of auscultation and percussion is now generally acknowledged; and we hesitate not to declare, that but for its aid we should consider the practice of medicine scarcely worthy of the name of a science. There is not a single celebrated physician in France who is not familiar with these methods. Other countries also acknowledge the utility of this part of diagnosis. Witness the numerous strangers who have done us the honour of attending our lectures; amongst whom we are pleased to mention Carbonaro, M.D. of the faculty of Palermo; Adragna, M.D. of the faculty of Naples; Krug, Mayer, Keiser, Krocker, M.D. of different German faculties; Kibare, George Rowe, Robert Gaye, Robert Boyd, Mitchell, M.D. of different faculties in England; Roch, Portuguese physician; Schweiger, Polish physician; Dusaix and Armaud, M.D. of Savoy; Inah and Hoopen, of North America.

But if, on the one hand, it be incontestable that the knowledge of auscultation and percussion has spread a light altogether new over the medical world; if in the place of empiricism it has substituted physical signs, conformable at once to reason and experience, it is also, on the other hand, too true that these methods of diagnosis, formed within these few years by first rate masters, are as yet but little attended to in the circles at a distance from the centre of the medical world.

We pretend not then to found a new system; we only aspire to pay a feeble homage to the authors of these useful discoveries, and accomplish the task which they have commenced, by giving popularity to the fruits of their immortal labours.

This path, once opened to their investigation, was rapidly traversed. Never, however, is it granted to an individual to observe every thing in a new path which he has struck out, and thus render useless the talents of those who follow him.

Auscultation and percussion, already precious in the hands of Laënnec, Avenbrugger, and Corvisart, have become much more so by the labours of Andral, Bouillaud, Louis, Piorry, Renaud, &c. *

This part of diagnosis, already so perfected, is still daily enriched by new facts; which, however, dispersed as they are in journals or works beyond the reach of every one, profit only the few. We have thought that a work, which would collect all these scattered acquisitions, and present them with method and clearness, would be useful. If we have permitted ourselves to add some observations of our own to the inheritance which we possess from others, we will request for them the indulgence of our readers.

But, in filling up this gap, we not only propose to propagate knowledge so important, but we have also

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* I think it right to notice that there is too often observable, amongst French medical authors, an inattention to the labours of their professional brethren in foreign countries. They are too apt to think that France is the world; a mistake which is, perhaps, to be attributed to their rarely visiting other countries. If this list had contained the names of no other foreign medical men, those of Dr. Elliotson, and Dr. Hope, should at least have been inserted.—*Note of the Translator*.

in view to put the key of the hospitals into the hands of the numerous students, to whom the clinical visits are fit only to inspire disgust and discouragement when they are unable to procure the preliminary notions, capable of rendering intelligible and interesting the diseases which present themselves to their view.

On the other hand, the experience of the senses and the application of the intelligence to the interpretation of the phenomena of auscultation, contain nothing strange to any student; and this exercise, serving as a transition from what is known to what is unknown, will habituate students to the observation of diseases, and make them adopt the usage of rigorous methods, by the aid of which they will have been initiated into all that we know, that is most positive and most useful, about diseases of the heart, the lungs, and the abdomen.

I ought publicly to testify my acknowledgment to Professor Bouillaud, whose wards, always rich in interesting cases, offered me a vast mine to explore; and if my work be of any service to the science and students, it is to this celebrated professor that we should be obliged.

We seize, also, with pleasure, this opportunity of thanking our excellent friend M. Jules Pelletan, Chef de Clinique, for the kindness with which he facilitated the means of giving our lectures at the Hôpital de la Charité.

Raciborski, D.M.P.

INTRODUCTION.

◆

UTILITY OF AUSCULTATION AND PERCUSSION.

Auscultation and Percussion are nothing more than the direct application of our senses to the diagnosis of certain diseases. These two methods, though very distinct, yet offer so many points of contact and analogy in their application, usage, and the natural aid they lend to each other, that I have not thought it proper to treat them separately.

The object of Auscultation (from the Latin auscultatio) is to recognise by aid of the sense of hearing, the different noises which take place during the discharge of the functions of different organs, and principally the organs of respiration and circulation.

Being first instructed by numerous observations (observations corroborated likewise by the general laws of physics), that a certain noise observed in an organ coincides with a certain pathological condition of the latter, we can easily recognise, by the aid of Auscultation, the seat and nature of the affections, which modify the *functional noises.* It is thus, that to him who is acquainted with the results of experience, the *râle* *crepitant* indicates the first stage of pneumonia, or an alteration in the vesiculæ pulmonales, and the *râle sibilant* denotes the existence of a catarrh, or an alteration in the bronchi.

Percussion consists in shocks executed principally by means of the fingers at the surface of different regions of the body; it makes them render different sounds, according to the different nature and state of their organs.

It is practised over a larger extent than auscultation. The latter, in fact, is only applicable in the regions which produce spontaneous noises, whilst the former can be practised over the whole surface of the body, though principally upon the parietes of the large cavities.

When we find a *dull* sound (*son mat*) in a region which yields a *clear* sound (*son clair*) in the normal condition, this anormal sound indicates that the organ corresponding to the region percussed is morbidly affected.

It will then be easy to recognise to which of the different organs this state belongs, by the knowledge of their relative position; and percussion will even become a valuable means of determining precisely the variations, either of situation or volume, which they may have undergone.

Thus it is known, that the portion of the hypochondriac region, situated immediately below the border of the false ribs of the right side, yields to percussion a clear sound when in a sound state.

If then this portion yield a dull sound, we shall have discovered an affection without having as yet precisely limited its immediate seat.

But if this dulness of sound extend upwards towards the liver, whilst it ceases lower down, we shall pronounce that there is hypertrophy of the liver, which also descends below the border of the false ribs.

If, instead of rising, this dulness of sound descend uninterruptedly as far as the region of the right ovarium, we shall know that it depends upon a tumour formed in this latter organ.

Even although auscultation and percussion should have had no other result than that of having greatly contributed to the progress of our information concerning the nature of affections of the respiratory organs, and of showing these affections in an altogether new and true light, this service alone would be invaluable.

In fact, before the present state of perfection of the different modes of percussion, and the discovery of auscultation, what inaccuracy presided over the diagnosis of diseases of the respiratory organs!

When gases, assembled in considerable quantity in the intestines, pressed the diaphragm against the lungs, so as to prevent the latter from executing their functions, the dyspnœa, consequent upon this state, was referred to some injury of the lungs, under the name of peripneumonia or pleurisy.

At other times it was an organic affection of the heart which gave rise to the dyspnœa, which physicians hesitated not to attribute to some injury or another of the lungs or their nerves.

In the times when dyspnœa and expectoration of blood were the principal characters of pneumonia, the veritable affections of the lungs must have been often misunderstood, and taken for morbid conditions altogether foreign.

Thus with old persons, in whom inflammations of the lungs are not often accompanied by any expectoration, but only by prostration of strength (a symptom common to all severe maladies which affect them), the physician was obliged not to suspect any thing but the existence of an adynamic fever, whilst they all the time were affected by pneumonia. Such was the state of medicine up to the end of the last, and even at the commencement of the present century. What Stoll described under the name of peripneumonia or bilious pleurisy, was nothing more, as Pinel has already very reasonably remarked, than a gastric obstruction sometimes complicated with bronchitis; and in the clinical lectures of Pinel himself, several cases of adynamic fevers might be found which amongst us of the present day would be nothing else than true inflammations of the lungs.

The prognosis could not be any better established than the diagnosis; and although, in default of positive indications respecting the state of the malady, the physician observed scrupulously all the changes which took place in its course, viz. in the pulse, the urine, the alvine evacuations, in order to foresee the termination; signs so incomplete, so variable and inconstant could not furnish a good diagnosis, nor rescue the prognosis from the incalculable dangers of inaccuracy and error.

Nowadays, that our profession possesses means of diagnosis much more positive, and claims fraternity with the exact sciences, the prognosis is essentially based upon the diagnosis, of which the former is but the interpretation. The latter once well established, nothing is more easy than to prognosticate according to the intensity of the affection and the importance of the parts affected. For instance, to give an example of the simplicity of the prognosis, merely with regard to affections of the respiratory organs; of two patients, of whom one has but a slight portion of one lung in the first stage of inflammation, and the other, an entire lung in a state of hepatisation,—*the second is much more dangerously ill than the first.*

The preceding is a prognosis very simple and evident to all the world, at the same time it is the pure interpretation of the diagnosis. If, then, it be to auscultation and percussion that we are indebted for our diagnosis, it is to them also that we owe our rational prognosis.

The same difficulties and the same mistakes which we have remarked in the diagnosis and prognosis of diseases of the lungs must have necessarily been encountered in their treatment; and then it is that they had consequences frightful and most generally irreparable.

Thus, on the one hand, imminent danger of a treatment inefficient or injurious.

In the case of pneumonia mistaken for adynamic fever, the physician commenced by lavishing stimulants on the patient, camphor, serpentary, &c., stimulants which, instead of raising the strength of the patient, only hastened his death; whereas blood-letting, acting as it would directly against the morbid affection, would have been the effectual means of restoring the patient's strength.

On the other hand, absence of positive signs to verify the effect of the treatment, the march of the malady, the progress of the mischief or the amelioration.

This ulterior absence of positive signs complicated in an extraordinary degree the difficulties of the treatment, it did not even leave the physician the resource of the expectant method, whereas auscultation and percussion again come to our aid, either to change a bad or continue a proper treatment, or modify and adapt it to the actual state of the patient.

Formerly the physician had not more exact data for verifying the cure; and for the same reasons that he did not suppose the existence of pneumonia in the affections where dyspnœa and expectoration of blood were not united; for those very reasons I say, and consequently, the affections which ceased to offer these characters were considered to have reached their cure. How many patients have fallen victims to this error? How many cases do we still at present see, where the patients are no longer affected with dyspnœa, and where their expectoration bears an excellent aspect, or does not at all exist, without the flame of the malady being yet fully extinguished!

If the patients, who are thus situated, be regarded as cured, and abandoned to the regimen of persons in health, or commit any indiscretions, the morbid flame, instead of being extinguished, is rekindled and will take a chronic march, which will hasten their dissolution.

We have observed more than once at the Hôpital de la Charité, in the service of professor Bouillaud, patients affected with pneumonia tell us that at the invasion of the malady they had been bled once before their entry, and that the principal symptoms having disappeared in consequence of this bleeding, the physicians had believed them to be cured, when rapidly, within a day or two, they commenced spitting blood, and experience anew the cough and difficulty of respiration.

Such is the cause of the majority of cases of pulmonary phthisis, which, whatever may be said on the subject, is but a chronic inflammation, sometimes primitive, sometimes consecutive to pneumonia or acute bronchitis, neglected or badly treated or incompletely cured; it is owing to the fault of not having recourse to auscultation and percussion, that similar errors are committed, and because the physician, not recognising well the state of the lungs after the first bleeding, does not pursue with vigour a treatment which has already produced a very marked amelioration.[1] Auscultation and percussion, detecting as they do the least vestiges of a pathological condition, will induce practitioners to combat the malady till its utter extinction by the same means which have abated it at its invasion.

All, then, which relates to affections of the lungs was unknown or misunderstood before the light which auscultation and percussion have thrown upon this subject. Thus it was only in the times anterior to their discovery, times when tubercles could be confounded with chronic catarrh, that certain physicians were able to enjoy the exclusive privilege of curing these affections, so often mortal. But, alas, how often has their usurped glory experienced reverses!

Nowadays uncertainty and ignorance have not given place to positive information, without often, it is true, exposing our impotency against tubercles of the lungs; but the cases of cure, although few in number, are become authentic and certain *. Another advantage

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* Upon a subject so interesting to humanity, and yet respecting which there has been so much incredulity amongst professional men, I cannot forbear referring the reader to professor Andral's Clinique Médicale, Maladies de Poitrine, tom. ii. page 368, and following, where the valuable observations of Laënnec on the cicatrisation of tuberculous excavations in the lungs, though called in question by many, have been confirmed and put beyond doubt.—*Note of Translator.*

has resulted to practice, that our patients are not subject to be blindly tampered with, but to treatment of which the success can be almost mathematically verified.

Let us now examine what has been the result of these discoveries, relative to diseases of the heart. It is to percussion and auscultation, united to the researches of modern morbid anatomists, that we owe the analysis of the different affections formerly comprised under the general term asthma. Nowadays we distinguish in asthma, sometimes affections of the heart, sometimes of the pericardium, sometimes of the pleuræ, sometimes of the lungs. It is by these two methods that some modern authors, and particularly Bouillaud, have arrived at recognising in the centre of circulation the different affections which were formerly confined to aneurism, active and passive. (Corvisart.)

These advances are not illusory, they are not confined to augmenting the number of diseases to which the human species are subject, but they considerably influence their treatment.

It would be a grievous error to believe that the diagnosis of the different affections of the heart is of slight importance, on the score that nearly the same treatment would be employed for all. In fact there are affections of the heart, where, instead of blood-letting, we are obliged to have recourse to steel and bark.

On the other hand, the same as in the affections of the respiratory organs, auscultation and percussion will give us positive signs, signs valuable for observing the progress of the malady and the effect or worth of the treatment.

It is by auscultation that professor Bouillaud arrived, some years back, at the discovery that the particular *souffle*, named by him the *bruit de diable*, and already observed in several arteries by Laënnec, exists constantly in the carotid arteries of those affected with chlorosis.

This accompanying sign of chlorosis has already more than once become very precious in practice *.

Have not likewise the affections of the abdomen found a valuable method of investigation in mediate percussion?

How often have pains in the epigastric region been taken for the signs of gastritis, whereas mediate percussion has discovered their seat in the left lobe of the liver?

Finally, one of the most happy applications of this latter method to diagnosis is that which has been made of it to pregnancy. It is known that the movements of the fœtus, regarded as the most certain sign of pregnancy, may sometimes completely fail, and that at other times hysterical females have fancied they have felt these movements without being pregnant.

Auscultation, detecting as it does the two noises of the fœtus, that of the beatings of the heart and the placenta, will not allow us any more to be led into error.

Surgery even has been able to deduce some advantages from auscultation.

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* Where the *bruit de diable* exists it denotes an impoverished state of the blood. Hence it is evident that the auscultation of different arteries, e. g. carotid, femoral, &c., may be of great service. For instance, if you wish to let more blood, but find by auscultation the *bruit de diable*, you will be deterred. Also since the *bruit de souffle* may be produced in an artery by compressing it, the presence of tumours may in certain cases be detected, or at any rate the opinion of their existence corroborated, by the auscultation of the arteries. As for instance, in the case of a tumour in one of the ovaria, compressing either of the iliac arteries.—*Note of Translator.*

We can more easily detect the crepitation of fractures by applying the ear to the member suspected of being fractured, than by keeping the ear at a distance.

Similarly the application of the ear to the hypogastric region often gives more certainty concerning the existence of a stone in the bladder, than the sensation of resistance which it generally affords to the shocks of the sound.

We cannot conclude these general remarks without adding that medicine altogether has gained by the introduction of auscultation and percussion.

Who can affirm that the cases, cited by the ancients as examples of essential fevers, and principally of inflammatory fevers, were not some latent affections of the lungs and the centre of circulation?

FIRST PART.

EXPLANATION OF DIFFERENT SIGNS OBTAINED BY PERCUSSION AND AUSCULTATION.

FIRST SECTION.

PERCUSSION.

CHAP. I.

Of Percussion in general.

> " I affirm after my own experience, that the sign of which we are speaking is of the greatest interest, not merely for recognising but also for curing diseases, and that it consequently deserves the first rank after the examination of the pulse and the respiration. In fact it is always an indication of the greatest danger, when the thorax is observed to yield an abnormal sound."—AVENBRUGGER.

1. Percussion is executed, as we have mentioned above, by striking, principally with the fingers, the different regions of the body. Its object is to recognise, by aid of the different sounds which it causes the organs to yield, their physical condition, as far as regards their dimension, their form, their consistence and density.

It is to Avenbrugger, physician of Vienna, that we owe the introduction of this method into medicine. It had not been known by any physician of antiquity, and justly deserved the name of inventum novum, by which its author designated it.

The first work of Avenbrugger upon this subject appeared at Vienna in 1763. In 1770 it was translated into French by Rozière de la Chassagne, who published this translation at the end of his manual on consumption. Nevertheless, as Corvisart says, who commenced his studies not long after this epoch, the name and method of Avenbrugger continued to be unknown.

Amongst the authors who wrote after Avenbrugger, Stoll is the only one who employed his method with advantage. Rozière de la Chassagne ingenuously declares that he never employed it himself.

It was not till fifty years after that Corvisart, on reading the works of Stoll, had the curiosity to make an attempt, with which he had so much ground to flatter himself, that he declared percussion to be exceedingly useful, and even indispensable, in many cases, to the diagnosis and treatment of diseases.

Corvisart, having thus revived percussion, which had been forgotten or rather misunderstood even amongst Avenbrugger's countrymen, might have claimed for himself the glory of inventor, especially as he had contributed to it some improvements. But equally modest as learned, he was content with the credit of having rendered a great service to the diagnosis of diseases of the thorax; and in publishing a translation with notes of the work of Avenbrugger, he rendered justice to the talent for observation and the inventive genius of this physician.

Avenbrugger applied percussion only to the organs contained in the thorax. His method consisted in a slow and gentle percussion, executed directly upon the thorax, by the extremities of the fingers drawn close to one another and elongated.

In order to avoid the confusion of the real sound of the organs with that produced by the shock of two naked surfaces, Avenbrugger recommended to cover the hand with a glove and never strike on the bare parietes.

Corvisart percussed with the flat of several fingers drawn together, Läennec with the stethoscope.

However, whatever be the procedure employed for executing immediate percussion, it presents many inherent incoveniences; the one in the procedure itself, the other in circumstances of organisation and the malady: for on the one hand it is impossible, whatever Avenbrugger may say, that immediate percussion can obtain marked sounds, without being executed with considerable force, and becoming painful. Neither will the shaking which it produces, be unattended with danger in inflammations of the respiratory organs; add, that it becomes impossible to compare sounds unequally elicited from the two sides of the thorax, and to rigorously limit injuries of small extent.

Besides, there are certain regions, as those of the shoulder-blades, the mammæ, the parts above the clavicle, which will always be difficultly percussed in this manner; another time it is the obesity, the anasarca or the swelling of the patients, which will render impossible the application of immediate percussion.

Finally, immediate percussion will prove extremely painful when the surface percussed happens to be covered with an exanthema or a blister.

The fact that it cannot be applied to the examination of the abdomen, deprives it still further of a great advantage. Indeed, the soft parietes of the abdominal cavity will never produce vibrations sufficiently marked to enable us fully to appreciate the state of the superficial organs, and cannot be sufficiently depressed for the exploration of those deeply seated.

These imperfections have caused the abandonment of this method; so that it is no longer adopted, except in certain cases, to recognise the degree of inflation of the abdomen.

Since the impulse given by Laënnec to medicine, by the happy application of auscultation to the diagnosis of certain diseases, several physicians have begun to be more fully impressed with the accordance between the physical signs observable externally, and the condition of our organs; and have felt, in à more lively manner, the insufficiency of immediate percussion.

2. The property possessed by certain solids, once put in vibration, of communicating that vibration to the bodies with which they are in relation, suggested to M. Piorry the idea of *mediate percussion,* which consists in percussing a plate of solid and elastic substance, applied to the region of the body proposed to be examined, in such a manner as to elicit vibrations of sound, which are propagated in the subjacent organs, and there changed into their proper tone *.

The name of plessimètre (from πλήσσω, "I strike," and μέτρον, "measure,") was given to the first instrument which was to perform the duty of an intermediate sonorous body. It consisted of a circular bit of deal, one line in thickness and two inches in diameter, supported by a vertical stem of the same wood fixed to a part of its circumference. At present this instrument has undergone different modifications in its nature and form; but the plessimètre of ivory, or that introduced by M. Louis, of India-rubber, are the only ones now used; in short, the finger is very frequently substituted for the two latter.

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* See the work of M. Piorry, De la Percussion Mediate, et des Signes obtenus à l'aide de ce nouveau Moyen.

General opinion is the best judge of the relative value of these instruments. The India-rubber, when percussed, always gives, owing to its elasticity, a peculiar sound which masks that of the organs. Indeed it is only used by M. Louis.

The ivory plate and the finger divide at present the choice of physicians. The former is nothing else than a circular plate, whose two surfaces are smooth and flat, and the upper one only surmounted by a rising border, either throughout the whole extent of the circumference, or only in two of its opposite points*.

It is by this border that the fingers hold the plessimètre.

In my opinion, the finger, composed as it is of bone and covered by soft parts, best unites the advantages of all the other instruments.

However, that will always be the best for us to which we have been accustomed; although I must assert, that it will be useful to unite the employ of the plessimètre with that of the finger.

When it is requisite to percuss the thorax of a thin person, the finger will be more easily applied to the intercostal spaces. The preference should likewise be given to its employ in the examination of the part of the lungs situated above the clavicle. In all the other cases we should willingly prefer the ivory plessimètre; to which, besides, we must always have recourse when it is requisite to explore the abdominal organs: for the soft parts of the finger would still further absorb the sound of these organs, already dulled by the thickness of the abdominal parietes.

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* M. Piorry has lately introduced a graduated plessimètre, which enables him to limit with considerable ease and accuracy, the organ subject to examination. It is the ordinary ivory plessimètre with the inches and lines marked on its upper surface.—*Note of Translator.*

The ivory plessimètre ought to be held between the fore-finger and thumb of the left hand, with sufficient force to prevent its slipping or oscillating, and then applied to the part proposed to be examined.

Its application should be made with great precision; it is necessary that the plessimètre form part, as it were (fasse corps), of the region upon which it is pressed, and that there exist no vacuum between the two. These are two essential conditions, and without which the results of percussion would be fallacious. If there existed a vacuum under the plessimètre, percussion would give a sound analogous to that of a cavern in the lungs.

Most frequently the plessimètre is placed immediately upon the surface of the skin. However, a thin layer of linen, as the presence of a chemise, will not have a marked influence upon the sound obtained. But, the instrument should never be placed upon a knitted covering*. In this case, percussion would experience the same inveniecomnce that we have remarked in the inexact application of the plessimètre.

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* Neither should you percuss upon a silk covering, on account of the rustling noise of the tissue. A flannel waistcoat also will absorb the sound, although, if the flannel be not thick, it will not materially alter the real sounds. These cautions are equally applicable in the use of the stethoscope.—*Note of Translator.*

You most generally percuss with the fore and middle fingers of the right hand united. The thumb is bent upon the fore finger, and the latter pressed against the middle finger. The extremities of these two fingers should be on a level, and the nails should not project.

The fore and middle fingers thus arranged, and kept obliquely in such a manner as to encounter the plessimètre with their pulpy extremity, but not with their nails, should in general strike gently. The fingers must be withdrawn as soon as the impulsion is given, in order to yield to the reaction. The shock should be rapid to produce sonorous vibrations.

All that we have said with regard to percussion with the plessimètre is applicable to that with the finger.

In using the finger for plessimètre, you should always strike upon the same phalanx, and the percussing finger ought always to keep the same angle with the percussed finger. This last precept is equally applicable to the plessimètre.

You most generally strike on the second phalanx of the fore finger of the left hand.

We have nothing to add to this statement of general rules relative to the manœuvre of percussion, except that it ought always to be executed as uniformly as possible, and principally in comparative examinations.

However, percussion will be practised with greater or less force, according to the thickness of the parietes of the regions examined, and the embonpoint and strength of the patients.

3. By percussing the different regions of the body according to these rules, you will obtain very different sounds, of which M. Piorry has formed the following scale:—

SOUND.	SOUND.		
F.	Fémoral,	Corresponding to the percussion of the	thigh.
J.	Jecoral,		liver.
C.	Cardial,		heart.
P.	Pulmonal,		lungs.
I.	Intestinal,		intestines.
S.	Stomacal,		stomach.
O.	Ostéal,		bones.
H.	Humorique,		organs filled with liquid and air.
Hy.	Hydatique,		hydatid tumour.
To complete this table we should add the *bruit de pot fêlé*, which should not be confounded with the *bruit humorique*			cavern filled with air and offering a narrow outlet.

The first six differences of sound belong to two principal classes. They are divided between the dull sound (*son mat*) and the clear sound (*son clair*), neither do these two offer a difference, except of degree. The greatest sound is given by the hollow, the less by the solid organs.

The four last degrees of the scale have a character altogether special, and fit to distinguish them from the first six; they vary as much in tone as in resonance. The first is produced by the percussion of organs very hard and sonorous of themselves, it is the sound of the bones.

The three following, having their seat in organs in an anormal condition, do not properly represent the sound of these organs, and are therefore designated under the name of *noises* (*bruits*).

The *bruit humorique* (better named *hydropneumatique*) sometimes exists in a normal condition.

If any region whatever give to percussion a clear sound (*son clair*), this shows that its organs contain air, and the resonance will be marked in proportion as the quantity of elastic fluid is considerable.

Hence it is that the lungs, which contain air in their vesicles, will yield a clear sound (*son clair, pulmonal*). The stomach, containing in its larger cavity a great quantity of gas, will also give a clear sound (*son clair, stomacal*), but louder and tolerably well imitative of a drum, whence it, as well as the intestinal sound, has received the name of *tympanique.*

All organs that are full, or have thick parietes, will yield on percussion a dull sound (*son mat*), and the dulness will be proportionate to the density of the organs, and their consistence.

It is true that the heart will yield a dull sound (*son mat, cardial*), but less dull than that of the liver; again, the thigh yields a sound still more dull than that of either the former organs.

Besides the characters resulting from the difference of sounds obtained by percussion, the passive resistance experienced by the fingers which percuss is also distinctive. For instance, if you percuss comparatively two livers, of which one is in a normal condition, and the other full of schirrous masses, the dull sound of these two organs will be accompanied with greater resistance in the latter case.

It must be perceived, that the practical distinction either of sounds or resistance, obtained by percussion, is derived less from any absolute character than from the comparison instituted in the same individual between the signs furnished by different organs.

CHAPTER II.

PERCUSSION OF THE THORAX.

Normal Condition.

The examination of the thorax is performed rather with reference to its osteological than its splanchnological division. It is then to the osteological thorax that we allude in this chapter.

The diaphragm divides into two parts the osteological thorax.

In the supradiaphragmatic thorax (splanchnological thorax, or thoracic cavity) we shall have to consider in connexion with percussion, the lungs, heart, and great vessels.

In the infradiaphragmatic portion (epigastrium and hypochondria) we shall study the liver, spleen, and stomach.

But before entering upon our subject, it will perhaps be as well to call to mind certain anatomical facts.

We have first to remark the direction of the diaphragm. This musculo-membranous partition, arched from one paries of the thorax to the other, takes an oblique direction from below upwards, from the third and second false ribs behind to the seventh and sixth true ribs before, and completely separates the two grand cavities of the trunk.

It is very important to keep in mind this disposition, in order to know thereby that of the parts situated above and below.

The right half of the thoracic cavity corresponds to the right lung.

The left half corresponds to the left lung and the heart, surmounted by the large vessels lying along the median line of the sternum.

The left lung, less in size than the right, and pressed outwards by the heart, only covers the external part of the left half of the diaphragm anteriorly. The other part corresponds to the heart, which is situated a little to the left of the median line of the sternum, and contained between the fifth and seventh ribs.

The anterior border of the lungs, shorter than the posterior, descends only as far as the sixth true rib, from the supraclavicular depression, which corresponds to the summit of the lungs before, and limits anteriorly the superior part of the thorax.

The posterior border of the lungs, thicker than the anterior, extends, on the contrary, from the fossæ supraspinatæ, corresponding to the summit of the lungs posteriorly, as far as the second and third false ribs by a lamina more and more thin and approximate to the vertebral column.

In the infradiaphragmatic portion of the right side (right hypochondrium), the superior part of the liver is limited by the passage of the diaphragm noticed above. The superior surface of that convex organ is, as it were, enchased in the concavity of the diaphragm and the base of the right lung, so much so that the posterior part of the base of the lung nearly corresponds to the level of the inferior surface of the liver. The anterior border of this latter surface corresponds nearly to the level of the edge of the right false ribs, and limits the right half of the osteological thorax inferiorly.

Towards the median line of the sternum, in the angle formed by the approximation of the cartilages of the false ribs of each side (epigastrium), are found the cardiac and pyloric portions of the stomach, of which the cul de sac takes its direction to the left, and occupies in a great measure the infra-diaphragmatic region of the left side of the thorax (left hypochondrium).

The inferior and altogether external part of this left side of the thorax belongs to the spleen, which corresponds to the two or three last false ribs, its position inclining backwards.

These two latter organs, together with the left false ribs, generally limit the inferior left half of the thorax.

By dedicating the preceding chapter to the recognition of the difference of sonorousness of organs of different structure, we have solved the following problem, viz. the structure of an organ being given, to find its sonorousness.

In applying these general data to the thoracic organs, the structure of which we know by anatomy, we perceive that, in a normal condition, the portion of the thoracic parietes which corresponds to the lungs (organs penetrated by air) will yield a clear sound (*son clair*); that the regions coresponding to the liver and the spleen will yield a sound more or less dull, according to the difference of density of these organs; that the precordial region will also yield a dull sound, though less marked, and accompanied with less resistance to the fingers, because the solid substance of the heart encloses liquid; that, finally, the region of the stomach (an organ filled with a considerable quantity of gas) will yield a clear sound—a loud clear sound called *tympanique;* or, if it contain gases mixed with liquids, *humorique,* or, again, even a sound more or less dull, owing to the presence of food.

The topography of organs in a normal condition, including the situation of each organ, or its relations of locality, and the space it occupies, or its dimensions, constitutes the second general problem of percussion.

This latter problem is solved by anatomy, and we have just recorded the most important characters.

We ought then by this time to possess all the elements at least of diagnosis, by means of percussion, of the normal and abnormal condition of organs. But the difficulties of application do not end with ideas purely theoretical. Thus, we cannot too often repeat it, it is only by the exact knowledge of the topography and the sonorousness of organs in a normal condition that we can draw faithful signs from percussion, and this knowledge cannot be acquired except by the repeated percussion of persons in health.

Percussion of the anterior Part of the Thorax.

During the examination of the anterior part of the thorax, the patient may maintain an upright or recumbent position. The arms should approach the body and the head be bent upon the latter to prevent the contraction of the pectorales and sterno—cleido-mastoidæi muscles, which might otherwise occasion a false dulness of sound.

If the patient be lying down, he should approach the edge of the bed, on the side of the examiner. Let us commence by the examination of the right side. We will first proceed to the examination of that part of the right lung which surpasses superiorly the clavicle.

In this examination of the supraclavicular region the patient should turn his head slightly to the opposite side.

The considerable depression of this region will produce some difficulty in the exact application of the plessimètre. For the most part it will be best to substitute in its place the fore finger placed in the direction of the clavicle; the last phalanx ought to be turned towards the neck, if you examine towards yourself; and exteriorly, if you do not examine on your own side.

In the latter case you may also direct the third phalanx inwards, by passing your arm behind the neck of the person you are examining.

The sound of this region is clear (*pulmonal*) in a normal condition.

In the examination of the infraclavicular portion of the chest, the plessimètre may be employed; with thin persons, however, the finger will suit still better, since its size does not exceed the distance of the intercostal spaces.

The sound of this region is likewise clear (*pulmonal*); but is somewhat dull in the region of the mammæ. For which reason, with stout persons and females, the percussion should here be executed with greater force, on account of the thickness of the parietes of the chest in this part.

Thus, in a normal condition, the whole extent of the chest, from the summit of the lungs to the sixth or seventh rib, yields a clear sound (*pulmonal*).

Reckoning from the sixth rib, or a little below, you begin to perceive the diminution of sound, the dulness of which, at first not very perceptible on account of a thin lamina of lung situated between the liver and the parietes of the chest, does not become very evident but in proportion as the percussion is executed with increased force.

But lower down, the dull sound is observable on the most gentle percussion, and continues as far as the border of the false ribs, beyond which you find the clear sound of the intestines. The distance, between the points at which this dulness of sound commences and those at which it ends, marks the height of the liver and the right hypochondrium.

By repeating the percussion in a vertical direction at different distances and always in parallel lines, and by noting each point of transition above and below the liver, you will have an exact idea of the superior and inferior limits of that organ.

All the points which belong to these superior limits correspond to the points of insertion of the diaphragm into the parietes of the thorax; and those points which establish its inferior limits coincide with the cartilaginous border of the false ribs, except internally, beginning from the salient angle of this border, where the liver passes it a little.

After having practised percussion in a vertical direction upon the right side of the chest, you should percuss the same part transversely.

The examination in a transverse direction of the infra-clavicular region, situated between the clavicle and the sixth or seventh rib, will verify afresh the clear sound of the lungs, but it will not detect its lateral limits, because the clear sound is prolonged outwards, below the axilla, and inwards, over the anterior mediastinum, except however at the level of the part of the mediastinum comprised between the fourth and sixth ribs, where you find dulness of sound (*matitè*) towards the sternum.

The transverse percussion of the part situated inferiorly, between the sixth rib and the border of the right false ribs (right hypochondrium), will give almost everywhere the dull sound of the liver, but this dulness will present different degrees, according to the height at which you percuss, as was the case in the vertical percussion.

Outwards, the dulness is prolonged uniformly as far as the posterior surface (prolongation of the liver backwards).

Inwards, the dulness of sound ends on this side of the median line; towards the superior part, the interior limit of the dulness of sound of the liver is found to be about an inch on this side of the median line, and the pulmonal succeeds to the dull sound as far as the heart; towards the inferior part, the dulness of sound (matité) surpasses by a little the interior part of the cartilaginous border of the right false ribs.

It is enough to unite the extreme points in order to obtain the internal limit of the liver.

In the rare instances where the heart is separated from the liver only by the diaphragm, the matité of the heart, although less pronounced than that of the liver, will only admit a well-practised observer to distinguish the transition from one organ to another. Lower down the tympanic sound of the stomach, which succeeds to the matitè of the liver in this direction, will not admit of any mistake in the determination of the lateral limit of this latter organ.

In percussing the right side of the thorax in a transverse direction, it will be necessary, when the examiner shall have arrived towards the superior border of the liver, to take the same precautions as in its examination in a vertical direction. The percussion should be executed with greater force, in order to draw forth the sound of the liver in this part from under the lamina of lung which covers it. Lower down, the slightest shock will afford matité and resistance to the finger. It is not thus at the altogether inferior part of the liver, especially internally, where it is prolonged only by a thin lamina which covers the intestines and the pyloric portion of the stomach, and the percussion should be very slight to verify its presence. Forcible percussion would communicate vibrations to the subjacent organs, whose tympanic sound would mask the matité of the organ by which they are covered.

Before passing from the right to the left side, let us first percuss the sternal portion of the chest.

On applying the plessimètre over the superior piece of the sternum, and percussing from above downwards, you will obtain, in the normal condition, the pulmonal sound as far as to within an inch and a half or two inches above the union of the ensiform cartilage with the sternum, where the presence of the right auricle of the heart will afford a slight matité without resistance. A little below, this matité disappears, and is succeeded by the tympanic sound of the stomach.

After having marked exactly the two points of transition with nitrate of silver, you proceed to the examination of the left half of the chest, which you manage like that of the right half. The percussion of the supra and infra-clavicular portions of the left side, from the summit of the lungs as far as the fourth true rib, will give exactly the same results as those of the corresponding parts of the opposite side. This resemblance of sonorousness ought to induce practitioners to repeat comparatively the examination now of the left and then of the right side, and that in all directions, in order to form a comparative diagnosis of the state of the lungs, one by the other.

When percussing transversely the superior part of the chest from the right half to the left half, you will perhaps be surprised that the sound given by the sternal portion which separates the two halves, does not materially differ from that given by the parietes which correspond with the lungs. But the sternal paries which covers the mediastinum does not correspond, superiorly, to any organ which can give a dull sound; besides, the sternum, acting as a large plessimètre applied over the lungs as well as over the mediastinum, will necessarily communicate vibrations to the former.

Below the fourth rib, the sonorousness of the two sides is no longer similar. In fact, the inferior part of the left is not occupied by the same organs as the inferior part of the right side. Instead of the liver we have the stomach inferiorly; the space comprised between the fourth and sixth ribs answers exactly to the lungs externally both to the right and left, but on the right side there is no organ which corresponds to the heart.

Thus, in putting the plessimètre about an inch to the left of the median line of the sternum and advancing it from above downwards, parallel to this line, you will find a commencement of matité (cardial sound) towards the fourth rib. This matité more pronounced than that of the left ventricle, continues as far as the sixth rib.

On uniting the points already noticed upon the sternum with the two latter, you will have the superior and inferior limits of the heart; the line which marks the superior limit of this organ would, if prolonged outwards, pass by the papilla, or a little below that eminence; the inferior line would pass by the depression which exists at the union of the xyphoid appendix to the sternum.

Beyond, in the left hypochondrium, the matité of the heart is succeeded by the tympanic sound of the stomach. The latter sound is heard afterwards as far as the border of the false ribs, when it is replaced by another variety of the tympanic sound.

Externally to the heart the pulmonal sound descends as far as the sixth and seventh ribs, and the stomacal sound (cul de sac of the stomach) succeeds it as far as the cartilaginous border of the false ribs. But you will meet with the dull sound of the spleen externally to the stomach, if the former be unusually developed.

The examination in a transverse direction, giving always the same results as that in a vertical one, is only more proper for determining the transverse diameter. You will apply it then to limit laterally, the heart, the stomach and the spleen, when the latter is developed at the anterior surface of the stomach.

We will explore the spleen at the posterior part of the thorax, which is its normal position; the stomach is too moveable and its dimensions too variable for us to be able to assign its precise limits.

We will therefore confine ourselves here to finding the transverse diameter and internal and external limits of the heart. For this purpose, advance transversely the plessimètre in the infra-clavicular region, drawing it nearer and nearer to the superior portion of the heart.

On meeting with this limit, already marked, of which besides you would be apprised by the succession of a dull to a clear sound, you will attentively pursue the transverse percussion, beginning from two or three inches to the right of the sternum, and advancing successively to the left.

In this course of the first transversal lines, still superior to the border of the liver, you will commonly observe to the right the clear sound of the lungs; upon the right border, or upon the median line of the sternum, a sound slightly dull, owing to the presence of the right auricle; this *matité* however is not accompanied by any resistance.

Sometimes the dulness will be manifest one inch to the right, or even more, but rarely at half an inch to the left of the sternum.

Beginning from its internal origin, the *matité* is prolonged and more intense towards the left, and is succeeded by the pulmonal sound.

In the course of transversal lines corresponding to the inferior part of the heart, you will observe to the right the *matité* of the liver, to which succeeds mediately or immediately that of the right portion of the heart, according as the latter is situated upon the median line of the sternum or to its right or its left, and as the liver itself extends more or less to the left.

If the slightly dull sound of the right ventricle succeed only *mediately* to the *matité* of the liver, the part of the lungs or mediastinum which separates them yields a pulmonal sound. If on the contrary the *matité* of the heart succeed that of the liver *immediately*, these two organs being only separated by the diaphragm, it will be very difficult to distinguish the exact transition from one to the other.

It is always sufficient to know the superior points of the internal boundary of the heart. You will obtain the approximate position of the other points by drawing a perpendicular to those which you have been able to obtain by percussion, just as you do, in a similar case, to delineate the internal boundary of the liver. Thus you will only have to determine the external boundary of the heart. This investigation will not offer any difficulty, since to the slightly dull sound of the right succeeds the more marked dull sound of the left ventricle, and then the pulmonal sound.

The surface of the heart thus determined by its *matité*, will offer a square of an inch and half or two inches *.

It is evident that this extent does not exactly correspond to the volume of the heart. You will easily account for this difference when you consider that in this region the left lung covers half the left ventricle. This part of the heart gives a clear sound on percussion, and it is the points of transition of the *matité* of the internal part of the left ventricle to the clear sound of the lamina of lung which covers its external part which we have taken for the lateral limit of the centre of circulation, externally. However, by carrying on the percussion more externally, you will observe another sensible transition, between the sound obtained in this latter part and that of the thoracic parietes which do not correspond to the heart.

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* It must be remembered that the French inch is longer than the English.—*Translator*.

But this latter investigation is not practised, because the extent of the surface of the heart which corresponds *immediately* to the parietes of the chest is always in the direct ratio of its volume, which cannot be augmented except by the lungs being pushed outwards.

Percussion of the Thorax posteriorly.

The examination of the thorax posteriorly offers equal interest with its examination anteriorly. In fact it is the thickest part of the lungs which corresponds to the vertebral fossæ, and is therefore, on account of its greater dimensions, more frequently exposed to affections.

The vertebral column percussed throughout the whole of its course that corresponds to the thorax, will give, as the author of immediate percussion has observed, a clear sound (pulmonal), resulting from its relation with the lungs as far as the second and third false ribs.

After the investigation of this median column, you will percuss the parts situated immediately to the right and left, and forming by their union a median zone, stretching from the summit of the thorax to its base, and lying between two perpendiculars passing along the vertebral border of the omoplates. Throughout the whole of its extent you ought to find, to the right as well as to the left, a clear sound (pulmonal) as far as the second and third false ribs, which correspond to a thin lamina of lungs internally.

But although this zone correspond immediately to the lungs, for almost the whole length of the thorax, the thickness of the latter at different heights, and sometimes the situation of subjacent organs abnormally developed, such as the heart, stomach, and liver, when the latter extends as far as the vertebral column, will have an influence over the sounds obtained. It is always easy to assign the nature as well as the situation of these modifications, and refer them to the organ to which they belong.

The two other zones which remain to be examined posteriorly, offer individually nearly the same transverse diameter as the median zone. They are limited *externally* by a vertical line passing through the posterior edge of the axilla; *inferiorly* by a line through the external points of the base of the thorax; *superiorly* by a line through the regiones supraspinatæ, which correspond to the summit of the posterior part of the lungs.

The regio supraspinata corresponding to the fossa supraspinata of the omoplate, will not give any remarkable sound except in proportion as the depression of the shoulder will admit percussion to be exercised without at the same time the thickness of the omoplate absorbing the sound.

You will then obtain in the normal condition a clear sound (pulmonal), but less marked than that of the anterior part of the chest, on account of the thickness of the muscles of this posterior part. However, as Corvisart has already remarked in immediate percussion, a little practice is sufficient to prevent your making a mistake. For the elasticity which you feel under the fingers when percussing, is sufficient to destroy the suspicions of a morbid condition, the existence of which might at first be presumed on account of the feebleness of the clear sound.

To percuss the regio infraspinata, the shoulder should be raised from the body by directing the arm upwards and outwards, or drawn close to the ribs by directing it downwards and inwards. In the first case the plessimètre will be applied to the ribs, and in the second the shoulder itself will be so exactly applied to the latter, that it will easily transmit to them its vibrations.

This region, limited below by the sixth or seventh ribs corresponding to the inferior angle of the omoplate, gives a clear sound (pulmonal), a little more evident than that of the regio supraspinata. Lower down the sonorousness is not similar on both sides: to the right, percussion gives the *matité* of the liver in the whole of this region, except at the internal part, the pulmonal sound of which superiorly is gradually lost in the *matité* of the liver inferiorly (the lung ending by a lamina more and more thin, a little externally to the median line). The percussion should be executed with force superiorly and internally, in order to bring out the *matité* of the liver from under the thin lamina of lungs which covers its superior and internal limits.

To the left you obtain the pulmonal sound very marked, which, whatever Avenbrugger may say, continues lower down than on the opposite side; it only ceases altogether inferiorly where the presence of the spleen yields a dull sound, less marked than that of the liver, for the extent of three or four inches. In a large number of cases indeed the spleen is very small and displaced inwards by the dilatation of the intestines and stomach, so that you find a tympanic sound in the region which should be occupied by the spleen.

The points of transition of the pulmonal sound to the *matité* of the liver, and of the latter to the tympanic sound of the stomach, will give us an exact idea of the superior and lateral limits of the liver. If the liver be separated from the kidney inferiorly by an intestinal ansa, the rapid transition of a dull to a tympanic sound and of resistance to the fingers to elasticity, will show us the inferior limits; but when the liver is contiguous to the kidney you can only get the approximate limit of this organ.

Percussion of the lateral surfaces of the Thorax.

The right and left axillary regions, limited anteriorly and posteriorly by the lateral boundaries of the anterior and posterior surfaces; superiorly by the axilla, inferiorly by the sixth and seventh ribs, give to percussion a clear pulmonal sound.

The inferior regions terminating at the base of the thorax, yield a sound analogous to that of the corresponding regions of the anterior surface. Thus the right inferior region, presenting superiorly the transition from a clear sound (pulmonal) to a dull sound (jecoral), presents the latter for the rest of its extent; beyond the thorax comes the clear sound of the intestines.

To the left, percussion gives the pulmonal sound superiorly, and the stomacal sound, when the stomach is distended; inferiorly the sound of this latter organ, and sometimes that of the spleen. Beyond the thorax the sound of the intestines offers itself as on the opposite side.

Such are the results which can be verified by the percussion of the thorax.

But it is necessary to take care to execute it with great uniformity, and to proportion the force of the impulsion to the thickness of the parietes.

Attention to the rules which we have laid down for the manœuvre of percussion is not without difficulty, but is acquired quickly by exercise.

We have already observed that the results obtained upon different subjects, offering indiscriminately a healthy condition, are not always identical.

This depends upon a difference of organisation, which, although somewhat irregular, is not the less normal.

This circumstance should induce beginners to examine persons of different conformation in order to learn the seat of each sound and its normal limits.

As to the distinctions drawn from the variety of the sonorousness of organs, they are perceived, when the difference is not very marked, not so much by the comparison with sounds obtained from a fundamental type primarily graven on the mind, as by the alteration which the ear detects as you pass from one organ to another.

Abnormal condition.

The clear sound of the lungs depends upon the presence of air in their vesicles. Whenever therefore there be an obstacle to the entrance of air into the vesicles, or the air be accumulated there in greater quantity than is required for the discharge of the function of respiration, there will be a morbid condition manifest on percussion.

Several causes may prevent the air from entering into the vesicles, as for instance:—

1. An effusion of liquid between the two pleuræ, compressing the parietes of the vesicles so as to destroy their cavity.

2. Pneumonia at the second or third stage (hepatisation of the lungs), where the cavities of the vesicles are obliterated, as well by the tumefaction of their parietes as by the concretion of sero-sanguineous or purulent matter which they contain.

3. Intra-vesicular and interlobular tubercles. The first hinder the entrance of air by filling the vesicular cavities, the latter, by compressing the exterior parietes of the vesicles, between which they take their rise in the interlobular tissue.

4. The dilatation of the bronchi, which compresses the parietes of the vesicles.

5. Finally, different tumours developed in the thoracic cavity, which sometimes only prevent the communication of the parietal vibrations to the lungs, but can also put an obstacle to the entrance of the air into the vesicles by compressing them, as in the case of interlobular tubercles.

At another time the obstacle confines itself to *diminishing* the quantity of air which enters into the vesicles, without completely preventing its arrival there, as for instance is done by the matter secreted from the parietes of the bronchi in catarrh, and by the parietes of the vesicles in pneumonia at the first stage, where there is only simple congestion, without complete obstruction.

In all the morbid conditions, the parts corresponding to the seat of the injuries enumerated will give an abnormal sound, which Avenbrugger has compared to that which results from the percussion of solid flesh.

The dulness of sound and the resistance will vary according to the density of the lamina of lung into which the air cannot penetrate, and according to the density of the foreign body which may occupy the place of air in the lungs.

When there is effusion, the dulness of sound varies its position, according as the liquid itself is displaced, and is only accompanied by a slight resistance to the fingers.

In catarrh, or pneumonia at the first stage, the dulness of sound, though not changeable in position, will be still less marked, and you will perceive but slight resistance to the fingers; whereas in pneumonia at the second or third stage, the dulness of sound is much more evident, and united to resistance so marked, that sometimes, as M. Piorry has observed, you will experience even a painful sensation on percussing the plessimètre applied exactly to the part of the lung in a state of hepatisation.

If tubercles prevent the air from entering into the vesicles, the percussion of the part of the parietes corresponding to their situation will give a dull sound, more or less marked, according to their development; and the resistance to the fingers, proportional to the tuberculous masses, will be considerable, and will cause, in certain cases, a sensation of hardness analogous to that of a bone.

As to the different tumours, which may be developed in the thorax, they will always give a dull sound and cause a resistance to the fingers, more or less marked according to their nature.

Corvisart has observed that the costal pleura becomes sufficiently thick towards the fourth day of its inflammation to cause dulness of sound.

We have actually under our observation a patient in whom, from the third day after the invasion of an inflammation of the pleura, we have verified this dulness of sound over a large portion of the left lateral surface of the chest, accompanied with incontestible signs of a false membrane, and without any trace of effusion in the cavity of the pleura.

In all the cases which we have passed in review, the abnormal condition has presented a default or diminution of air in the respiratory organs, and has been distinguished by dulness of sound and by a greater or less resistance to the fingers. In the following cases, on the contrary, the morbid condition, resulting from the presence of a too considerable quantity of air in the respiratory organs, will be shown by a clearness of sound greater than that in a normal condition.

This latter phenomenon will be observed—

1. In dilatation of the vesicles by air (vesicular emphysema);

2. In certain cases of dilatation of the bronchi;

3. In pneumothorax and hydropneumothorax, where there is a small quantity of liquid and a considerable quantity of gas.

In these two latter cases, the tympanic sound is owing to gases enclosed in the cavity of the pleuræ, either in consequence of a gaseous exhalation of the pleura, or in consequence of the rupture of a cavern in that cavity.

Finally, when a large cavern, not yet broken, be filled with a considerable quantity of air, percussion will likewise produce a loud clear sound; but in this case, the cavern being imperforate on the side of the pleura, and therefore the air being forced to escape at each impulsion of the parietes, the tone of the sound will be so modified, as perfectly to resemble the noise of a cracked earthenware vessel when struck with the finger (*bruit de pot fêlé*).

You will also obtain an exact idea of this noise by joining, as children often do, the palms of both hands, so as to form a cavity imperfectly closed, and striking the hands thus united against the knees. The compressed air, escaping by a slight opening analogous to the calibre of the bronchi, will produce the same noise.

It is not therefore to the presence of liquids that we ought to refer this noise, as those authors have done who have called it *bruit humorique* or *hydropneumatique* *.

Its resemblance with the sound of metal when struck has caused it also to be designated under the name of *tintement metallique*†. But all these expressions giving a false or equivocal idea, we shall adopt exclusively the denomination of *bruit de pot fêlé*.

To obtain the *bruit de pot fêlé* very marked, it is necessary to make the patient open the mouth partially, to give a freer issue to the air. If the mouth and nostrils were exactly closed, this phenomenon would immediately disappear.

To finish all that we have to say upon the diagnosis of the state of the lungs by percussion, we ought to add that the examination of this double organ ought to be made comparatively on both sides of the chest.

The sonorousness of even the same lung during inspiration and the retention of air, and during expiration, ought equally to be the object of an attentive comparison. Thus, if you find an obscure sound in a region which corresponds to the lungs, before deciding

* "Noise arising from liquid or from liquid and air."—*Translator.*

† "Ringing of Metal."—*Translator.*

that there is disease, you should, according to the advice of Avenbrugger, order the patient to take an inspiration and hold his breath, then to expire; and you should percuss the chest in each of these circumstances. If the lung be indurated, the air will not be able to enter in greater quantity during the inspiration, and the sound will be the same before and after the expulsion of air; similarity which is not met with in lungs in a healthy condition.

We have said that, in a healthy condition, the stomach yields a tympanic sound in the inferior part of the left half of the thorax, comprised between the seventh and tenth ribs. But it may happen that this organ, distended by a considerable quantity of gas, may press upwards the diaphragm and adjacent parts, so as to present a tympanic sound as far as the fifth rib.

The affections of the heart have also a marked influence upon the degree of dulness of sound and resistance of that region, and upon the extent over which these two characters present themselves. It is thus that the congestion of blood in the heart, the presence of a considerable quantity of coagulated blood in its cavities, hypertrophy, particularly if accompanied with dilatation, effusion in the pericardium, &c., will be indicated by dulness of sound and an increased resistance, and the heart, pressing back the lungs by the augmentation of its volume, will produce these signs over a more considerable space.

The liver as well as the spleen may equally give a dull sound beyond the limits which they have in a healthy condition.

Sometimes it is the superior border of the liver which, by hypertrophy or congestion of that organ, extends beyond its habitual limits; sometimes it is the left lobe, which extends as far as the cul de sac of the stomach, sometimes even as far as the spleen, and the dulness of sound extends with that organ. If there be scirrhous masses in the substance of the liver, it will oppose a very marked resistance to the fingers. The presence of hydatids will present on percussion a particular *frémissement*, analogous to that which would be produced by a repeating watch, with its case placed upon the palm of the left hand, when percussed upon the glass with the fingers of the other hand. The vibrations of the watch are owing to the oscillations of the bell of the machinery; in an hydatid sac the *frémissement* depends upon the oscillations of the hydatids. M. Briançon, in a thesis maintained on this subject at the Faculty of Medicine, asserts that this *frémissement* is in the direct ratio of the number of hydatids, and in the inverse ratio of the liquid, the presence of which however is absolutely necessary to its existence.

The spleen, although less subject than the liver to disease, is still not exempt from it; one of its principal affections is hypertrophy*, the limits of which will be determined by the dulness of sound in the region.

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* The frequency of congestion of the spleen in intermittent fevers should engage practitioners always to percuss this organ in such cases, and should the treatment of this disease by digitalis, applied to the region of the spleen according to the endermic method, be found to be equally successful in general as it has hitherto been in the hands of some practitioners, the percussion of the spleen will become of greater interest and importance. It may here be observed for the benefit of those who percuss this organ when affected, that congestion of the spleen comes on and is reduced with great rapidity.—*Note of Translator.*

CHAP. III.

PERCUSSION OF THE ABDOMEN.

Normal Condition.

We shall include in the percussion of the abdomen all the organs situated between the base of the osteological thorax and the superior circumference of the pelvis.

The anterior abdominal paries, of greater extent than the posterior, is extremely elongated in the median line, where it corresponds superiorly to the hollow at the base of the thorax, and inferiorly to the symphysis pubis.

During the examination of the abdominal organs, the patient should lie on his back and the muscles of the abdomen be relaxed. This latter indication will be answered by making the patient bend the leg on the thigh and the thigh upon the pelvis.

The ivory plessimètre is almost exclusively employed in the percussion of the abdominal organs. The finger is neither sufficiently large, nor can it be so firmly applied to the lax parietes of the abdomen as to depress them properly.

On percussing transversely the anterior part of the base of the thorax, we have found to the right the dull sound of the liver, to the left the tympanitic sound of the stomach. If we percuss the abdomen in the same direction, beginning from the limits of the osteological thorax, we find in the hollow at the base of the thorax the tympanitic sound (*stomacal*) of the cardiac and pyloric regions of the stomach, though somewhat less clear than that of the external part of the same organ.

Lower down, the transverse colon, stretching to the right and left, immediately below the liver and stomach, gives the tympanitic sound (*intestinal*), but a little less clear than that of the stomach. All the part situated below (supra-umbilical, umbilical, and infra-umbilical regions), yields the tympanitic sound (*intestinal*) in a greater or less degree.

The percussion of the abdomen in a vertical direction offers us equally striking results: let us commence with the right side, taking our point of departure from the first curvature of the colon, we shall thus descend along the ascending part of this intestine as far as the cæcum. In all this course the sound will be more or less clear; but the cæcum, being almost exclusively filled with gas, will yield a very loud tympanitic sound, (*stomacal*) so to speak, a circumstance of which we shall take advantage hereafter. You will then proceed gradually inwards with the percussion as far as the linea alba. In the whole of this extent you ought to find the tympanitic sound, arising from the intestines, and particularly the small ones, filled with gas.

The linea alba, corresponding in the hollow at the base of the thorax to the pyloric region of the stomach, will also yield a tympanitic sound during the whole of its course down to the os pubis. We shall likewise find the tympanitic intestinal sound in all the left half of the abdomen.

Abnormal Condition.

The abnormal sound yielded by the abdominal parietes in a morbid condition differs from the normal sound, sometimes by its greater clearness either in a single organ, as in the case of dilatation of the stomach, or over the whole extent of the abdomen, as in the case of tympanitis; sometimes, on the contrary, by its dulness of sound. This dulness may be likewise more or less, and is accompanied by proportional resistance. The boundaries of this dulness of sound are difficult to circumscribe in the intestines, but it is more fixed and limited when it corresponds to hypertrophy of the liver, the spleen, &c., or to different tumours in the abdomen.

In a healthy state, percussion gives no sign of the presence of the bladder, the uterus, and the ovaria, and if you find dulness of sound in a region corresponding to the seat of these organs, it will on that very account become an indication of disease.

The percussion of the posterior part of the trunk corresponding to the abdomen offers very little interest. It is exceedingly difficult exactly to define the kidneys in their normal condition through the thick layer of muscles of this region; and their morbid alterations, not generally affecting their volume, are not consequently to be detected by percussion.

An important precaution to take in the examination of the abdomen is to apply the plessimètre sometimes superficially, and at other times deeply, by depressing it, in order to examine successively the superficial and deeply-seated organs.

If a tumour exist on one side of the abdomen, an assistant placed at the opposite side should draw the intestines towards him, in order to avoid the confusion of the sound of the tumour with the tympanitic sound of the intestines.

The examiner, once thoroughly impressed with these general suggestions, will know exactly how to avoid the difficulties which are met with in the manœuvre, and will be able to practise with advantage the percussion of the thoracic and abdominal organs. The majority of the signs obtained will be unequivocal. But I should repeat, in conclusion, that this appreciation of the material qualities of the organs cannot be too scrupulously nice, nor the mensuration too exact.

SECOND SECTION.

AUSCULTATION.

CHAP. I.

OF AUSCULTATION IN GENERAL.

THE object of auscultation is to discover, by means of the ear, the noises of different organs during the discharge of their functions, and principally the organs of respiration and circulation.

Hippocrates even applied his ear to the parietes of the thorax in certain affections, as we are convinced by the following passage:—

"You will learn by this that the thorax contains water and not pus; and so, on applying the ear during a certain time upon the sides, you hear a noise reresembling the agitation of boiling vinegar." (De Morbis ii.*)

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* The above is the translation given by the author. I think it right to mention that there is considerable obscurity in the passage in the original owing to the different readings, and that the reading which has been here followed is given only upon the authority of Cornarius, a translator of Hippocrates, and against that of all the MSS., which read ὄζει instead of ζει. (See the passage.)

It may be said that this observation does not alter the fact of Hippocrates having sometimes applied his ear to the thorax for the purpose

Although in this passage the Father of Medicine, in announcing that a noise, analogous to the ebullition of vinegar, denotes the existence of a purulent effusion in the cavity of the pleuræ, has made a mistake, it is no less true that he had discovered in the thorax a particular noise, which was doubtless the *râle-crepitant* or *sous-crepitant* *.

That which astonishes us is, that this celebrated observer did not make further researches on this subject. And it is still more remarkable that none of his successors should have profited by this observation, and discovered the series of phenomena to which it opened the road.

Auscultation only dates from 1816. Before this epoch we were only acquainted with inspection, succussion, mensuration, and immediate percussion. It was not till after Laënnec had seen, at the clinical visits of Corvisart, his fellow-student, Bayle, apply his ear to the region of the heart to examine that organ, that he conceived the idea of auscultation, which method he applied to the lungs and centre of circulation.

The first instrument which he employed for prosecuting his researches was a trumpet-shaped cylinder made of pasteboard. Having afterwards made several trials, he found that wood was the most advantageous substance, and had a cylinder made of sixteen lines in

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of auscultation. I admit this, but am still far from thinking my caution with regard to the authenticity of this passage to be unimportant, at least as far as regards the history of the subject; for should the passage, as here given, be a true translation of the original, it would follow, not only that Hippocrates had sometimes made use of auscultation, but that he had so far progressed as to give distinguishing names to different noises. This would imply a degree of perfection hardly consistent with his not having mentioned the subject in any other part of his writings.—*Note of Translator.*

* "Crackling, or slightly crackling noise."

diameter and one foot in length, pierced longitudinally by a canal of three lines in diameter, but widened at its extremities. This instrument, called stethoscope (from στῆθος "chest," and σκοπέω "I examine"), was formed of two equal pieces screwed together. The enlargement of the inferior part of the canal was exactly filled by a cone of the same substance, which was also pierced by a canal of equal calibre with that of the middle piece of the instrument. This part was called the *embout* or *obturateur.*

The stethoscope was employed to conduct to the ear the sounds developed in the organs examined. When it was requisite to examine the respiration, Laënnec recommended the removal of the *obturateur*, which, however, in the examination of the heart, he considered to be useful.

Since that time this instrument has undergone several modifications, the most useful of which has been the reduction of its size*.

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* The best stethoscope is that which most completely fulfils the conditions of a good hearing trumpet in a small compass.

It should conduct to the ear the sounds produced at a distance rather augmented than diminished, and consequently its interior should be of a conical shape.

The greater the dimensions of the base, or the inferior orifice, in comparison with the superior orifice, the louder will be the noise transmitted to the ear, since the vibrations concentrated towards the superior orifice are the union of the sonorous vibrations impressed at all the parts of the base of the column of air.

The *embout* or *obturateur*, which Laënnec recommends to add to the stethoscope in the examination of the heart, has for an immediate effect, to equalise the diameter of the tube in all its extent; and, for mediate effect, to diminish the noise.

If, then, the diminution of the base could have any advantageous result, it would not be the augmentation of the noise towards the superior orifice, but its more exact localisation, or the determination of the exact point of the heart in which it was formed.

At any rate, let it not be supposed that solids conduct sounds better than air, an error which has arisen from a misconception of an observation of Laënnec.

At present the stethoscope of M. Piorry, to which that practitioner has united with considerable advantage the plessimetre, appears to us for that reason the most advantageous; it scarcely differs at all from the stethoscope of M. Louis, these two instruments being each composed of a cylinder seven or eight inches in length, pierced longitudinally by a canal widening more or less rapidly, and terminating by an ivory disc to which the ear is applied.

All these instruments preserve, according to Laënnec's first model, the *embout* or *obturateur*. The utility of this solid piece, the addition of which appeared to the discoverer of auscultation to render the instrument fit for the examination of the heart, is far from being evident to us.

I make use myself of the stethoscope of M. Piorry, having substituted in place of the *embout* a crayon of nitrate of silver*.

M. Montdezert has modified the ordinary stethoscope, so as to adapt it to the examination of the posterior surface of the body of a patient lying on his back, by giving it a flexible tube made of gold-beater's skin containing a spiral twist of wire.

Immediately after the introduction of auscultation its importance was generally recognised, and put in practice. It was not so with the stethoscope.

On reading Laënnec's work we should be tempted to think that he attached more importance to the instrument than the discovery, which is become of incalculable utility. Other physicians substituted the naked ear for the stethoscope, and arrived at the same result. The utility of the stethoscope was thus called in question, and both one and the other have now-a-days their exclusive partisans.

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* This is for the purpose of marking the limits of different organs as determined by percussion.

It is of great advantage in estimating the increase or decrease of volume of the diseased organ, and modifying the treatment accordingly. —*Note of Translator.*

As it is always more convenient to make use of the instruments which nature has given us, you may auscult with the naked ear whenever any causes, preventive of the propagation of sound, do not put an obstacle in the way.

When it is required to examine the respiration over a plain and extensive surface, as, for example, over the anterior and posterior surfaces of the chest, immediate auscultation will even be more advantageous, because all the half of the face which corresponds to the ear employed in auscultation will propagate the sound by means of the superior maxillary, the cheek bone, and bones of the skull.

But when it is requisite to auscult the supra-clavicular and infra-axillary regions, or to determine precisely the character of the arterial noises, and those of the centre of circulation, which take place in a small surface and are mingled with the noises of respiration, in all these cases the stethoscope will be employed with much greater advantage. Perhaps, also, cerebral congestion, which occurs more frequently in a bent than an upright posture, so affects the sense of hearing, as to render it less acute; this, if the case, is a motive, particularly with plethoric persons, for preferring the use of the stethoscope.

Whether the examiner makes use of the stethoscope or simply the ear, he should place himself on the same side as the region which he proposes to examine, and avoid all kind of extraneous noises capable of distracting his hearing.

You may apply the ear or stethoscope either immediately upon the skin or upon a thin layer of linen. The application should be exceedingly exact and yet delicate. The instrument should be kept in place by means of the fore-finger and thumb of the hand corresponding to the ear employed. The latter should be applied directly over the bore of the stethoscope.

We add that auscultation should ordinarily be preceded by percussion. The latter indicates whether the state of the organs be morbid or normal, whilst the former analyses the abnormal condition and determines its nature.

The researches of auscultation, like those of percussion, should be made comparatively on both sides and over several points of the chest. If you discover a morbid condition in a point of the thorax anteriorly, it will be advisable to examine the same point posteriorly in the direction diametrically opposite.

But before proceeding to the examination of organs in a morbid state, it is necessary, as in percussion, to be well acquainted with the normal condition. You will attain this object by repeated experiments upon individuals of different constitutions.

CHAPTER II.

STRUCTURE OF THE LUNGS.

BEFORE speaking of the different phenomena presented by the organs of respiration, either in a healthy or morbid condition, we shall prepare and smooth the way for the study of these conditions, by reporting the different researches in which several authors, and particularly Reisseisen, have engaged, upon the subject of the internal structure of the lungs.

Malphighi, in his time, presumed that the parenchyma of the lungs was only formed of the minute ramifications of the bronchi: "Unde fortasse tunica illa interna tracheæ in sinus et vesiculas terminata consimilem inchoatis vulgo spongiis vesicularum molem efficit."

But Helvetius rejected this opinion of his predecessor, maintaining that the vesicles of Malphighi were nothing else than the cellular tissue of cellules communicating on all sides and attached to the extremity of the bronchi. According to this theory he conceived respiration to take place by the passage of air from one cellule to another, from one lobule to the neighbouring one, and so on to the whole of the lungs.

Such was pretty nearly the opinion of Haller.

We shall now give the conclusive experiments by which Reisseisen has established and developed the opinion of Malphighi, now-a-days generally adopted, and succinctly recorded in the excellent treatise of anatomy by M. Jules Cloquet.

1*st Experiment.*—After having longitudinally divided the trachea, bronchi, and their divisions, he observed that the mucous membrane, beginning from the trachea, was continued as far as the surface of the lungs, forming in its course a canal, at first simple, then divided into canaliculi, more and more short and numerous, terminating in a cul de sac, and communicating with each other by their orifices at the commencement of their ramification, but without any communication with the rest of the lungs.

This termination in a cul de sac of the minute ramifications of the bronchi, constitutes the pulmonary vesicles, which, assembled in certain number and placed in juxta-position, form lobules, each of which is separated from the neighbouring one by a thin lamina of cellular tissue pervaded by vessels and nerves.

2*nd Experiment.*—The same observer, having separated one of the bronchi corresponding to a lobe of the lungs, inflated the whole lung by the trachea, and afterwards tied this bronchus and ceased to inflate.

The whole lung then collapsed, except the lobule which received the bronchus, the ligature of which prevented the escape of the air; an exception which would not have taken place, if the lungs were formed of cellules communicating with one another.

3*rd Experiment.*—Reisseisen detached a lobule of the lungs and carefully removed from it the surrounding cellular tissue. This lobule inflated and then tied at its upper part and left to itself in that state, remained distended with air.

He repeated the experiment under water, and did not perceive any bubble of air traverse the liquid.

It is altogether different with the interlobular cellular tissue.

Inflations of air into the interlobular tissue effected by a slight incision made upon the pulmonary pleura, spread one after another and formed bubbles of various sizes, completely analogous to those of emphysema, which disappeared with difficulty when the inflation ceased.

Shall we object with Haller to the two latter experiments, that each lobule is formed only of a collection of cellules, but that the cellular tissue of each lobule is enveloped at its circumference by impenetrable membranes, which prevent the air from passing from one lobule to another?

The dissections of Reisseisen demonstrate that these membranous envelopes are imaginary, and that the pulmonary lobules are only separated from one another by surrounding cellular tissue: on the other hand it is still better proved, by the following experiments, that the lobular tissue is only formed by the vascular ramifications of the bronchi terminating in vesicles.

4th Experiment.—Reisseisen having poured mercury into a principal bronchus of another pulmonary lobule, detached like the preceding, pushed the metal down to the surface of the lungs with the handle of a scalpel. Then, by the aid of a simple lens, he was enabled to observe the columns of mercury traversing the tubes (which become more and more short and numerous as they are at a distance from the superior divisions), as far as the pleura, where the mercury terminated in globules.

If you press a lobule thus injected between two plates of glass, the mercury pressed down with greater force into the minute ramifications, will represent still more exactly the form of the termination of the respiratory canals, the extreme ramusculi of which resemble nodosities; and the pulmonary vesicles are like the tubercles of a cauliflower.

To put beyond all doubt the result of the preceding experiment, and in order that sceptical opponents might not attribute the linear direction of the mercury to false paths formed by its specific gravity, Reisseisen varied the experiment in the following manner.

5th Experiment.—He plunged in cold water a fresh calf's lung. Some days afterwards this lung, considerably collapsed owing to its being in a great measure void of air, of which the vesicles contained only a few bubbles, was thrown into warm water. The caloric having dilated the little quantity of air which remained in some of the vesicles, Reisseisen was able easily to observe them, distended as they were, in the middle of a compact mass formed by the approach of the other compressed pulmonary vesicles.

On observing more closely the lobules thus distended, and on pressing the air towards the pleura, he perceived the same structure as in the preceding experiment.

This is not exactly the opinion of M. Cruveilhier, who pretends that a lobule is an agglomeration of cellules and vesicles, which all communicate one with another and correspond to a single division of the bronchi, as to a common pedicle. This difference, however, does not affect the explanation which we shall give of the phenomena of respiration.

"After the bronchi enter the lungs, the cartilaginous rings lose their form and become only irregular laminæ, which constitute segments forming by their re-union a complete ring; so that there no longer exists a membranous portion, properly so called, and the divisions of the bronchi are completely cylindrical.

"The segments of the divisions of the bronchi are perfectly oblong, curvilinear, and terminating in angles completely elongated, arranged so that they can ride one upon another, and be reciprocally received into their intervals. They are besides united together by a fibrous tissue.

"This disposition in curvilinear and angular segments exists as far as the last bifurcation of the bronchi; but the volume of these segments continues to diminish, so that they soon form merely narrow lines and finally cartilaginous tubercles.

"The fibrous and membranous portion of the cylinder gains more and more upon the cartilaginous portion, which ceases at the level of the last bifurcation of the bronchi, by a tubercle which occupies the angle of this bifurcation. The last ramification of the bronchi is reduced to its *membranous part.*"—*Anat. Descriptive,* Tom. II. p. 643.

According to Reisseisen, at each point of division of the bronchi you see rings, more or less complete, for keeping the orifice open.

The bronchi have the two orders of muscular fibres observable in the trachea, the longitudinal and the circular fibres. Reisseisen thinks that these fibres are prolonged as far as the extreme ramifications of the bronchi and the pulmonary vesicles.

The experiments of Varnier seem to confirm his opinion: in fact Varnier has excited the contractility of the extreme ramusculi of the bronchi, not merely by injecting into them liquids and inflating them with irritating vapours, but still further by irritating mechanically their external surface.

M. Cruveilhier does not admit of fibres in the vesicles. Finally, the lungs contain the ramifications of the pulmonary artery and veins, of lymphatic vessels and of nerves.

CHAPTER III.

AUSCULTATION OF RESPIRATION, AND OF THE VOICE IN THE NORMAL CONDITION.

If you auscult any part of the chest corresponding to the lungs you hear, at each movement of inspiration and expiration, a prolonged murmur corresponding to the gradual expansion and contraction of the pulmonary vesicles, and to the friction of the air against their parietes.

It is difficult to give an exact description of this murmur, or to compare it to any known noise; but in order to fix it on the memory, it is sufficient to hear it once.

In mentioning the circumstances of its production, we have explained the mechanism by which it is formed. The friction of the air against the parietes of the bronchi and vesicles appears to us, as it did to Laënnec, the simple cause of its formation.

Latterly, a young physician, M. Beau, has given out an opinion altogether different. According to him, the noise of normal respiration is produced "by the resonance, in the whole column of air inspired and expired, of the noise resulting from the pressure of this column against the soft palate and adjoining parts *."

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* Archives Générales de Medicine IIe serie, tome 5.

So paradoxical an opinion would require for its support conclusive experiments and close induction; all the experiments however of M. Beau, were they exact, are far from speaking in favour of his opinion.

If he has heard the *souffle bronchique* less distinctly in the case where the patient, affected with an effusion in the cavity of the pleuræ, breathed without making any noise in the trachea, this coincidence of the effect of the passage of the air in the trachea and bronchi agrees very well with the general opinion.

In the case cited by the author of this theory the respiration was only superficial, and the air entered in too small a quantity into the bronchi for the *souffle bronchique* to be distinctly heard.

"When the guttural noise is suspended," says the author of this memoir, "the tracheal and vesicular noises no longer exist, the respiration, although silent, takes place as usual, and if you did not feel under the ear the thoracic parietes retire and advance alternately, you might believe that the individual did not breathe."

That would be another instance of the coincidence of the guttural with the tracheal and vesicular noises. We object to M. Beau, that if there were no other signs of respiration but those afforded by the depression and elevation of the thorax, it is very probable that respiration did not take place, and that if it occurred without noise, it was because the air did not arrive in sufficient quantity nor rapidly enough to produce it; and that the reasons for which the tracheal and vesicular noises did not exist, are precisely those which would hinder the formation of the guttural sound.

As to our own experience, it has furnished us with results directly contrary. The patients, who, surprised by the order given them to respire, make more noise in the trachea, have in that case the respiration very slightly remarkable; on the other hand, I have distinctly heard the respiratory murmur, although feeble, in persons with whom the soft palate made no noise. But to meet with these cases you must choose persons with whom the expansion of the lungs is habitually very marked, or whose respiration is puerile.

Although M. Beau pretends to have heard normal respiration, by blowing through a tube of paper against the soft palate of another person who held his breath, we have in vain tried the same experiments several times without ever obtaining analogous results. Most generally we have heard nothing in the chest, but sometimes an echo of the noise produced in the throat; that echo however had no analogy with the murmur of respiration. Besides, this fact would be no more conclusive than the others.

If you add to these reasons the simplicity of our theory and the incoherence of that of M. Beau, it is astonishing that such a paradox should find partisans.

We have however attempted to throw some light on this subject by experiments on animals. We have, together with M. Auguste Pelletier, attentively auscultated the respiration of a rabbit in health, which we found very analogous to the *souffle* that, in man, accompanies injuries of the valves of the heart.

After having severed the trachea, the same *souffle* continued. The animal quickly died. We then commenced a new kind of experiment; M. Pelletier and myself respired through the trachea by means of a small tin tube, taking care not to make any noise with the mouth, and each time we heard a *souffle*, altogether resembling that which we had found during life, and yet our soft palates were different from that of the rabbit; the respiratory murmur was more analogous to that of the animal in proportion as we more exactly imitated its short accelerated respiration.

It is then well demonstrated that the mechanism of the respiratory murmur is such as we have described.

The noise of the respiration is not the same in all individuals, nor in all points of the chest. There are persons, as Laënnec has observed, who naturally have the respiration very feeble, without the lungs being affected, whereas others have it ordinarily very loud and almost puerile.

In general, if the respiration, whether more feeble or stronger than usual, be heard over the whole chest, it is more probable that it is not the sign of a morbid state of the lungs, than if it be heard, under either one or other of these forms, only over a small surface.

However, the respiration is not heard with the same intensity over all the parts of the chest; which results either from the greater thickness of the lungs, or from the vesicles being more permeable in one region than another.

In fact, M. Cruveilhier is convinced by a great number of experiments, that the lobules are unequally permeable, that a moderate inflation of the lungs, being made as much as possible within the limits of an ordinary inspiration, does not perhaps dilate the third part of the pulmonary lobules; he observes also, as Broussais has done before, that the lobules most permeable are those of the summit, whence it would result that they acted more habitually than the other parts of the lungs*.

It is in the anterior and superior regions of the chest that the respiratory murmur is the most marked in a normal condition. It is a little more obscure in the corresponding part behind. In the inter-scapular region the respiration is more *soufflante* ("blowing") than any where else. This is on account of the root of the lungs and the bronchi which exist in this part being of considerable calibre.

The trachea causes a *souffle* ("blowing noise"), still more marked, to be heard, indicating the capacity of the tube in which it is produced.

Between the liver and the vertebral column the respiration is feeble, because in this part the lung is prolonged by a very thin lamina; over all the extent occupied by the liver alone, the respiration is null; it is equally so in the region of the heart, except however in the rare cases in which the left lung covers the centre of circulation.

On applying the ear over the inferior part of the thoracic cavity, anteriorly and posteriorly, you sometimes hear the gargouillement ("bubbling noise") of the intestines or the stomach, which must not be taken for any abnormal noise of the respiration.

In the normal condition, the pulmonary approaches the costal pleura during each respiration, but without producing any noise distinct from the respiration.

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* A reason also probably why an inflammation of the summit of the lungs is more dangerous than that of any other part.—*Note of Translator.*

When you make the individual, under examination, talk, the voice resounds over the whole extent of the chest corresponding to the lungs, and produces vibrations easily felt by the ear, but which seem to be arrested at the surface of the thoracic parietes, without arriving at the internal part of the ear.

Towards the root of the lungs, under the axilla, and especially upon the trachea, the resonance is stronger, and the vibrations seem to be propagated as far as the ear, which sometimes feels a disagreeable sensation, principally when ausculting thin persons or those with a shrill voice.

Such characters of the normal resonance of the voice in these parts, have a near alliance with *bronchophonie**, of which we shall speak presently.

When you apply the hand upon the chest of an individual talking, you feel, in a normal condition, a gentle but sensible vibration.

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* *βρόγχος* and *φωνὴ*, "resonance of the voice in the bronchi."—*Note of Translator.*

CHAP. IV.

AUSCULTATION OF RESPIRATION AND OF THE VOICE IN A MORBID STATE.

Abnormal Respiration.

To have a proper idea of what we are going to say in this chapter, we should recollect that there are three distinct parts in the lungs. 1st, the bronchi; 2nd, the vesicles; 3rd, the pleuræ. When these three parts are free from injury, the air passes freely from the bronchi to the vesicles, producing a particular murmur proper to normal respiration. The lung inflated by the air introduced during each inspiration approaches the parietes of the chest, and the pulmonary touches the costal pleura, without their contact producing any particular noise.

1. But there are cases where each of the three pulmonary laminæ (bronchi, vesicles and pleuræ) continue to be in a sound state, and where, notwithstanding, the respiratory murmur is much more marked than in a normal condition. This form of respiration is normal with all infants, which circumstance has given it the name of *puerile respiration.* But its presence in adults most generally indicates an affection of the lungs, not

that the affection has its seat in the parts which offer this character, but because the increase of the force of respiration observed in one lung argues a weakness in respiration, either in other parts of the same lung, or in the opposite one. Thus, as the author of Auscultation has observed, when one lung becomes inactive, the other fulfils its functions by redoubling its own energies.

What is the cause of this augmentation of the vesicular expansion? We do not think with some authors, that puerile respiration depends upon hypertrophy of the lungs, or, in other terms, upon the augmentation of the number of vesicles. The rapidity with which this form of respiration manifests itself in different affections of the lungs, puts out of the question all idea of hypertrophy, properly so called, and induces us to admit the opinion of Cruveilhier.

This anatomist says, that he has frequently observed lobules in the lungs, which are, so to speak, in reserve, and only act in profound respirations. (Anat. Descrip., t. ii. p. 622.)

Upon the strength of this observation, we think with this professor, that puerile respiration depends upon the entrance of the air into a larger number of vesicles than in the normal condition.

2. Another augmentation of the respiration takes place in dilatation of the bronchi.

The respiration is exceedingly noisy; the ear easily detects the air passing through tubes of a large calibre, before entering into the vesicles, of which a considerable part is become impenetrable to the air, on account of the compression created by the parietes of the dilated bronchi.

In this case the respiratory murmur is almost completely masked by the *souffle bronchique diffus*, ("diffuse blowing noise in the bronchi").

3. Another time, the dilatation being more circumscribed forms a kind of cavern in the tube of the bronchus; and the destruction of the parenchyma of the lungs, resulting from the *ramollissement* of tubercles, may also form a cavern completely empty, which communicates superiorly by means of the bronchi, with the rest of the lungs.

In these two cases, the passage of the air into the dilated portion will there offer, during each inspiration and expiration, a resonance proportionate to the extent of the cavern.

It is to this modification of the respiratory murmur, that the name of *respiration caverneuse*, or *souffle caverneux* ("hollow respiration," or "hollow blowing noise"), has been given.

The *souffle caverneux* is more remarkable in proportion as the cavern is larger and more superficial.

4. When the capacity of the cavern is exceedingly great, and does not perpetually contain liquid, or only a little, you will hear during respiration a resonance analogous to that obtained by blowing into a decanter, keeping the mouth at a little distance from the neck. It is the same mechanism in both cases. A large cavern resembles well enough a decanter, and its neck a bronchus; it is therefore not without reason that this kind of cavernous respiration has been called *respiration amphorique*, (from amphora, "flask").

When a superficial cavern bursts in the cavity of the pleuræ, the air entering into that cavity during each inspiration produces the *respiration amphorique*, more marked in proportion as the cavity of the pleura contains little or no liquid.

5. In other cases the air penetrates the respiratory organs without producing any noise, and the two movements of respiration are silent.

After obstinate catarrhs, the parietes of the bronchi and pulmonary vesicles, immoderately distended by the continued efforts of coughing, lose their elasticity or their facility of contraction, the same as the abdominal parietes after long dropsies or repeated pregnancies.

Such is the organic injury which accompanies the *extinction* of the respiratory murmur in the vesicular emphysema of Laënnec.

In this affection, the vesicles and bronchi not contracting after their expansion, the act of expiration is incomplete, the air inspired remains in these parts, and keeps them dilated; so that the fresh supplies of air which arrive at each inspiration are no longer capable of producing the murmur arising from the gradual expansion of the vesicles.

Laënnec gave another explanation of this silence, which he attributed to the obliteration or impenetrability of the vesicles; but in that case you ought to hear the *souffle bronchique* arising from the passage of the air in the bronchi.

The discoverer of Auscultation attributed the absence of the latter noise to the rarefaction of the tissue of the lungs, rendering them unfit to conduct the sounds developed within them; but this explanation is only hypothetical.

We have said at the commencement of the chapter, that the air passes from the trachea into the bronchi and from the bronchi into the vesicles, and that its passage in each of these parts is accompanied by a particular noise, of which the vesicular noise is more extensive than the others, and properly constitutes the respiratory murmur in a normal condition.

We have observed successively the augmentation of the respiratory murmur in the vesicles, when the vesicular lamina became more penetrable, and its increased resonance, on the contrary, in the dilated bronchi, and in a cavern of the lungs, where the air arrived in greater quantity; we have next observed the vesicular murmur disappear, without the passage of the air being more distinctly heard in the bronchi, when the vesicles, without ceasing to be permeable, have lost their elasticity, as well as the bronchi.

6. But if, from any cause whatever, the cavities of the vesicles were obliterated whilst the bronchi remained in a normal condition, the vesicular murmur would be replaced by the *souffle bronchique,* called also *respiration bronchique,* or *tubaire.*

This noise, which resounds in tubes of normal calibre, cannot be confounded with the *souffle bronchique diffus,* in dilated bronchi, and does not completely mask the vesicular murmur.

Thus, when an effusion in the cavity of the pleura compresses the parietes of the vesicles, and obliterates their cavity, the respiration is confined to the bronchi, and you hear the *souffle bronchique* instead of the vesicular murmur.

The same phenomenon takes place in pneumonia at the second and third stages, where the pulmonary vesicles are no longer permeable.

It takes place also in the pulmonary apoplexy of

Laënnec, which consists in the obstruction of the cavities of the vesicles by the coagulation of extravasated blood.

When tubercles are formed in the pulmonary vesicles, the vesicles are pretty nearly in the same condition as in the second and third stages of pneumonia. The obstacle to the vesicular respiration in this case arises from the obstruction of the vesicles by tubercles. But if the tubercles be formed in the interlobular tissue, they will compress, on the contrary, the vesicles from without inwards, in the manner of effusions, and you will always have the *souffle bronchique.*

Before passing to the other alterations of the noise of respiration, we will speak of the abnormal noises produced by the approach of the two pleuræ.

7. When vesicular emphysema, in which we have already verified the *extinction* of the noise of respiration, takes a progressive course, there arrives a moment when the rupture of the vesicles takes place, and the air, after having forced a passage in the interlobular cellular tissue, producing thereby a particular râle ("rattle"), which we shall notice presently, arrives at the surface of the pleura, which it raises up, by forming bubbles. These, owing to the friction during the approach of the pleuræ, produces another noise, called by Laënnec, *bruit de frottement ascendant et descendant,* ("noise from friction, ascending and descending,") so called, because it takes place equally during the elevation and depression of the chest.

A similar noise is heard whenever a false membrane exists between the two pleuræ, whether this false membrane adheres only to one of them, or extends from one to the other.

The intensity of this noise, produced by the same mechanism as the preceding, will vary according to the nature and density of the false membrane.

If it be altogether recent and soft, you will only hear a slight *frottement* ("rubbing noise, friction").

A false membrane, fibrous and large, gives generally a noise analogous to that of rubbed parchment (*parchemin froissé*), sometimes to the noise of new leather (*bruit de cuir neuf*).

In other cases, you hear a real *grating* sound (*bruit de râpe.*)

Whenever the noises of the pleura are intense, the hand, if applied over the parietes of the chest, will feel peculiar vibrations, called *fremissement cataire*, a circumstance also met with in certain injuries of the valves of the heart.

In all cases which we have cited, the air has penetrated more or less profoundly in the respiratory organs, but has had no obstacles to surmount in its passage; in the following cases, on the contrary, the passage of the air will experience more or less difficulty, and give rise to new noises, comprised under the name of *râles* or *rhonchus*, ("rattling or snoring noises").

8. One of them, which we have alluded to in speaking of the *bruit de frottement ascendant et descendant*, has been known since Laënnec's time by the name of *craquement* ("crackling"), or *râle crépitant sec, à grosses bulles*, ("dry crackling noise, with formation of large bubbles"); it takes place when, in pulmonary emphysema, the distension becomes greater and greater, and is followed by the rupture of the vesicles. The air then forcing itself a passage in the interlobular cellular tissue, gives rise to this phenomenon during inspiration.

9. In the early stage of catarrh, when there is congestion of the mucous membrane, it frequently happens that the tube of a bronchus is contracted at some point of its course, and there forms a sort of glottis, which vibrates at every passage of air, and produces a particular noise, called "*râle sonore grave*," or "*râle bronchique sec*," ("deep sonorous rattle," or "dry rattle of the bronchi"). The intensity of this noise is proportionate to the congestion of the membrane.

10. When there is stricture of a bronchus to a considerable extent, as is the case in certain acute and also chronic catarrhs, not accompanied with expectoration, the air passing along the narrow passage of the contracted bronchus produces a noise analogous to that of a current of air passing through a key-hole. The ear perceives the difficulty which the fluid experiences in its passage by the whistling noise (*sifflement*) which is heard, to which has been given the name of *râle sibilant* (*sibilus*, "hissing"). This *râle* accompanies the two movements of respiration, but is more marked during expiration. This difference is thus accounted for by Dance, viz. the movements of expiration not being so energetical as those of inspiration, the air experiences more difficulty in the former case in traversing the contracted bronchus. This explanation appears singular *.

The contraction of the calibre of a bronchus, which occasions the phenomenon, may be produced, either by the congestion of the mucous membrane, or, which is the most general case, by a lamina of viscid mucus lining the membrane, whence it happens that the *râles sonore grave et sibilant* may exist and disappear within a very short space of time, according as you auscult before or after expectoration.

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* Certainly this explanation does not very well agree with that of the mechanism of the sound brought forward as analogous to and illustrative of the *râle sibilant*, viz. the whistling noise produced by the passage of a current of air through a key-hole; for in this case the whistling sound is greater in proportion as the current of air is stronger, or, in other words, as the force with which it is impelled is more energetic; and less or altogether null, according as the force of the current diminishes.—*Note of Translator.*

Let us next examine the modifications of the noise of respiration, owing to the *displacing* of different liquids by the passage of the air into the lungs.

To have a good idea of the different varieties of noises occasioned by the displacing of liquids secreted or exhaled by the mucous membrane, you should take pipes of different calibre, and fill them with solutions of gum Arabic of different consistence. By inflating air into each of them by means of a common tube, you will obtain various noises, differing according to the dimensions of the pipe and consistence of the solution.

11. The displacing of mucous matter in the trachea, during the latter moments of life, occasions the *râle trachéal* ("rattle in the trachea").

12. The displacing of a liquid of an analogous consistence collected in a larger cavity, as in a cavern, will produce a different noise, known under the name of *râle caverneux* or *gargouillement* ("hollow bubbling noise"). If the cavern be large, this *râle* will very nearly resemble the gurgling of a bottle (*glouglou d'une bouteille*); if, on the contrary, the cavern be small, it will not differ from the *râle muqueux*.

13. The *râle muqueux* is heard whenever liquids are collected in the passages of smaller calibre, as in the bronchi of the first order. The ear applied over the parietes of the chest distinguishes not merely the calibre of the

tubes in which the sound is formed, but even the consistence of the secretions. This *râle* frequently accompanies hæmoptysis, and catarrhs attended with mucous secretions. The ear detects the elevation and depression of these liquids by the passage of air, and also that the bubbles which they form with the latter do not break until they have acquired a considerable size.

14. If with this râle be combined those which we know under the name of *râle sibilant* and *râle sonore grave*, the union of these noises will very nearly resemble the cooing (*roucoulement*) of turtle doves and pigeons, or the cries of different birds.

15. If the liquids displaced be secreted by bronchi of the second order, the air traversing these tubes of smaller calibre will produce a somewhat different noise, called *râle sous-crépitant*. The crepitation which characterises this noise results from the rupture of bubbles of the size of large pearls.

16. If the morbid secretion take place in the vesicles, as is the case in the first stage of pneumonia, where the pulmonary vesicles being inflamed exhale a sero-sanguineous and viscous substance, the air penetrating this substance during inspiration forms bubbles there, the number of which is proportionate to that of the inflamed vesicles, and their rupture accompanied by a crepitation analogous to that produced by the ebullition of any fat substance, or the crackling noise of salt upon burning coals; this is the *râle crépitant*. One of the characters which distinguishes the *râle crépitant* from the *râles muqueux et sous-crépitant*, with which it may sometimes be confounded, is that the bubbles of the *râle crépitant* are all equal, as are the cavities of the vesicles wherein

they are formed, whereas in the other râles the size of the bubbles may vary considerably.

Dance, the author of this ingenious explanation of the production of the *râle crépitant*, says that this noise is only heard during inspiration. This fact arises, in my opinion, from the following circumstance: the viscous substance being confined in the cul-de-sac of the vesicles, beyond which the air cannot pass during inspiration, no longer obstructs the passage of the air during expiration.

Another distinctive character established by Dance between the *râle crépitant* and the other humid râles is, that the first persists after expectoration, whereas the others disappear.

The persistency of the *râle crépitant* after expectoration appears to me to depend upon this—that the substance expectorated in pneumonia does not come immediately from the pulmonary vesicles, but from the bronchi, which receive the surplus of what the vesicles are unable to contain.

There are besides two remarkable phenomena discovered by auscultation of the lungs.

17. When a cavern bursts in the cavity of the pleura, this cavity contains a collection of liquids proceeding from the broken cavern, or afterwards secreted by the inflamed pleura. In this case auscultation will frequently detect in the chest a particular noise, called by Laënnec *tintement métallique* ("ringing noise of metal").

The author of auscultation attributed the *tintement métallique* to the vibration of the air at the surface of the liquid, when the latter is agitated by the respiration, the voice, or coughing.

Dance brings forward the following opinion with regard to the formation of this noise:—

When the level of the liquid contained in the cavity of the pleura is superior to the orifice of the cavern, the air which enters at each inspiration into the lungs rushes into the cavity of the pleura, rises through the liquid in the shape of a bubble, by reason of its specific gravity being less, and arrives at the surface, where the bubble breaks and produces the *tintement métallique.*

This observation had passed unnoticed. It is only lately that M. Beau, without knowing the observation of Dance, happened to suggest the same idea, which he explained and verified by numerous experiments.

The *tintement métallique,* for which M. Beau has substituted the name of *tintement bullaire,* can be equally heard, according to this practitioner, during expiration, coughing, talking, and expectoration. In fact, he observes, although in all these acts the air be expired instead of inspired, still, since in the majority of cases of the presence of caverns the surrounding part of the lungs is hardened, and does not collapse during expiration, the air, expelled from the rest of the lung, rushes from the trachea into the open bronchi, and from thence acts as air inspired. Most commonly this noise follows each act of respiration; sometimes however it takes place slowly, which seems to arise from the circumstance that the bubbles before bursting may stop some time at the surface of the liquid.

According to M. Beau, the same noise is sometimes heard in large caverns filled in a great measure with liquid, and in hydropneumothorax, without any communication with the respiratory passages. But in these two circumstances it is difficult to conceive the formation and rupture of bubbles, and must we not admit in certain cases of *tintement métallique* the simple explanation of this noise given by Laënnec in the case when it accompanies the rupture of caverns in the cavity of the pleura?

18. It happens frequently with patients in these conditions, that, when they change a horizontal for an upright posture, drops of liquid, adhering to the pleura, or retained by false membranes, become separated from the mass of liquid which falls to the inferior part of the cavity. These drops, by falling on the surface of the liquid, occasion a noise analogous to that produced by the fall of a drop of water in a decanter containing a certain quantity of liquid. This is a variety of the *tintement metallique*.

19. The cases in which the *tintement metallique* is observed, present, moreover, another phenomenon.

Whenever the cavity of the pleura, or a large cavern in the lungs, contains liquids and gases, you will hear, when you shake the thorax, the fluctuation of the liquid; this is called by Hippocrates *succussion*, and since his time has been known under the name of *Hippocratic* succussion. You may imitate this phenomenon by shaking a decanter containing a small quantity of liquid.

Abnormal Resonance of the Voice through the Parietes of the Chest.

We said above, that the resonance of the voice is very distinct in the regions where the bronchi are superficial, but less so in those regions which correspond to laminæ of vesicles, on account of the numerous divisions experienced by the undulations of sound in arriving at the extreme ramifications of the bronchi.

1. Hence, if the cavities of the vesicles be destroyed by any cause whatever, the voice will resound in the bronchi corresponding to the obliterated vesicles, and that in proportion to the greater or less extent of the obliteration. This abnormal resonance of the voice through the parietes of the chest is called *voix bronchique, or bronchophonie.*

The impenetrability of the cavities of the vesicles, whether it result from the presence of tubercles, or from the concretion of sero-sanguineous matter secreted by the parietes of the vesicles in the second stage of pneumonia, will therefore occasion this phenomenon.

2. The same phenomenon is observable when the impenetrability of the vesicles is produced by an effusion in the cavity of the pleura. But if, in this case, the liquid be in too small a quantity to compress entirely the lamina of vesicles, and only causes a closer application of the pleura to the parietes of the vesicles, so as to form therewith a membrane more or less tense, applied to the extremities of the respiratory passages, the resonance of the voice will in this case offer a very remarkable character. It is a broken, interrupted sound, like the voice of a person who stutters. It has been compared to the bleating of a goat, whence its name of *égophonie* (αἲξ, αἰγὸς, and φωνή).

According to certain modern writers, *l'égophonie* is an uncertain sign. I am far from thinking that it is always easy to appreciate this sign; I think, however, that with practice and attention it may be distinguished from all other signs.

3. When the respiratory passages are dilated over a

more or less circumscribed portion, as is the case in partial dilatation of a bronchus, or in an excavation of the lungs consequent upon tubercles, the resonance of the voice in these different parts is such, that the patient seems to talk in the ear of the examiner, especially if the latter auscult with the stethoscope. This is *pectoriloquie* (pectus and loquor), which is complete when the cavern is superficial; and adheres by its parietes to the costal pleura, and when the surrounding portion of the lung is indurated.

If the bronchi be dilated to a considerable extent, the resonance of the voice will very nearly resemble *pectoriloquie;* but it will be more *diffuse,* and may be heard over several different points of the chest.

The hand applied over the parietes of the chest during *bronchophonie,* feels the *parietal vibrations* as in a normal condition.

This phenomenon is no longer met with when the lungs are separated from the thoracic parietes by a certain quantity of liquid.

CHAPTER V.

AUSCULTATION OF THE CIRCULATION OF THE BLOOD.

ARTICLE I.

Auscultation of the Heart.

AUSCULTATION is equally applicable to the heart as to the lungs. But to have a good idea of the phenomena presented by this organ in the discharge of its function, we should first have a correct notion of its mechanism.

We proceed then to enter upon such anatomical and physiological considerations as relate to our subject.

I make a point of acknowledging that a large number of the facts brought forward in this chapter are due to Professor Bouillaud, to whose labours it is that the science owes so profound a knowledge of the centre of circulation and its diseases. I have collected them partly at the clinical visits of this professor, partly from a new work written by him, which he has had the goodness to put into my hands, although not yet published.

Anatomy of the Heart.

The heart is a hollow muscle having the form of an inverted cone. Its volume cannot be absolutely fixed.

Laënnec observed, that it is generally a little less, equal to, or a little greater than the volume of the fist of the same subject.

This organ is situated in the left cavity of the chest, where it occupies the region which corresponds to the inferior part of the sternum, and to the cartilages of the lowermost true ribs of the left side. Its position is such that its base looks upwards, backwards, and to the right; whereas its point is turned to the left, forwards and downwards, at the level of the fifth intercostal space. Thus situated in the anterior mediastinum, and retained in its position by the fibro-serous bag of the pericardium, in which it is enclosed, the heart reposes below upon the muscular paries (diaphragm) which separates the chest from the abdomen.

The anterior border of the right lung advances a little anteriorly upon the right portion of the pericardium and the corresponding half of the heart, whilst the anterior border of the left lung, advancing equally upon the left portion of the pericardium, covers in a great measure the left cavities of the heart. The portion, therefore, of the pericardium which is not ordinarily covered by the lungs, belongs principally to the right cavities, and particularly to two thirds of the anterior surface of the right ventricle; it presents the figure of a lozenge, and may be from an inch and half to two inches square. The number of subjects with whom the lungs completely cover the pericardium is very small.

"The heart is formed of two symmetrical halves, and if such an expression may be used, of two hearts placed back to back (*adossés l'un à l'autre*); the one right, anterior and inferior, the other left, posterior and superior. This division is marked exteriorly by a slight depression passing along its surfaces, and traversed by the coronary arteries. Another depression, deeper and circular, separates transversely the heart into two other unequal parts, called auricles and ventricles.

“ Thus the heart, a truly double organ, is composed of four cavities, viz. two ventricles and two auricles, the former constituting in some sort the *chamber of the pump*, represented by the heart, the latter forming the reservoir. Each heart is composed of one auricle and one ventricle, which, in the healthy adult, do not communicate directly with the corresponding cavities of the opposite heart.

“ The two ventricles form the principal part of the heart, constituting its two anterior or inferior thirds. The left ventricle is thicker, stronger, and more muscular than the right; a large vessel, known under the name of the aorta, goes off from its base; from the base of the right ventricle there rises another, designed under the name of the pulmonary artery.

“ The auricles, surmounted at their anterior part by the appendix auricularis, receive the insertion of several veins; these being for the right auricle, the superior and inferior venæ cavæ; and for the left, the four pulmonary veins. This relation of different parts of the heart with the large vessels has caused the right ventricle to be called the pulmonary ventricle, and the left the aortic ventricle; the left auricle, the sinus of the venæ cavæ, and the right auricle the sinus of the pulmonary veins.

“ The four cavities of which the heart is composed have parietes of unequal density. These cavities are so disposed, that, in the adult, the left and right cavities do not immediately communicate one with another.

“ But the two cavities of each moiety of the heart communicate with one another by means of an opening called the auriculo-ventricular orifice.

“The cavity of the ventricles, separated from one another by a common partition, presents the orifices of the pulmonary artery and aorta.

“The aortic and pulmonary orifices, as well as the right and left auriculo-ventricular orifices, are furnished with membranous folds, designed under the name of valves. The aortic and pulmonary valves are to the number of three for each orifice, and are designed under the name of sigmoid valves, a denomination which gives a sufficiently exact idea of their figure; they are also called semilunar valves. The free edge of each of these valves offers at its middle part a small tubercle, called the tubercle of Aurantius. The valves which are adapted to the auriculo-ventricular orifices have their free edges indented by a great number of small denticulations, and are besides divided deeply into three principal tongues in the right ventricle, and into only two in the left ventricle. Owing to this disposition, the name of Tricuspid valve has been given to that which is attached to the right auriculo-ventricular opening, and the name of Bicuspid valve, or valvula mitralis, to that of the left auriculo-ventricular orifice. When the valves are raised, they stop up the orifices to which they are adapted, in the manner of the suckers of a pump.

“The auriculo-ventricular orifices, the circumference of which is elliptical, whilst that of the orifice of the aorta and the pulmonary artery is circular, are bordered by a whitish line or zone, more apparent on the side of the auricles, and which is owing to the projection caused by a fibrous or tendinous ring, enclosed in the substance of the heart itself.

"The cavity of the two ventricles does not offer exactly the same form; that of the right is irregularly round, oval; that of the left is conoidal. The cavity of the first is larger than that of the second, whereas the latter has greater height or length than the former. The cavity of the right ventricle not descending so low as that of the left, it follows that the apex of the heart really belongs entirely and exclusively to the left ventricle. The direction of the cavity of the right ventricle is not parallel to that of the cavity of the left ventricle; on the contrary, the axis of the former, ideally prolonged, crosses at an acute angle the axis of the latter. But let us examine still more minutely the disposition of the cavity of each ventricle. It is an interesting point of anatomy which our predecessors have scarcely touched upon.

"The cavity of each ventricle is composed of two very distinct portions; the one opens almost directly into the auriculo-ventricular orifice; the other, on the contrary, into the arterial orifice which is situated at the base of each ventricle. These two portions of the ventricular cavity are not constituted altogether in the same manner on the right and left sides. In the right ventricle, the *pulmonary* portion (I call it thus because it opens into the pulmonary artery) is united to the *auricular* portion (that which opens into the auricle) by means of a kind of angle, the sinus of which is turned upwards.

"In the left ventricle, the *aortic* and *auricular* regions or portions are parallel to one another*, and take a vertical direction. They are separated from one another by the right or anterior lamina of the bicuspid valve, and by two large fleshy columns which go to be inserted there by means of numerous tendons; it is below, backwards, and to the outside of this sort of partition or bridge that the auricular portion is situated, whereas the aortic portion, larger than the other, is situated above, forwards and inwards. These portions communicate freely with one another at the interval which separates the two voluminous columns mentioned above.

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* Owing to the conical form of the ventricle, these two regions approach one another, in proportion as they proceed from the base of this ventricle to its apex; they are not therefore exactly parallel.—*Note of M. Bouillaud.*

"It is in the auricular portion of each ventricle that the principal fleshy columns exist. Indeed, a large portion of the aortic and pulmonary regions is entirely destitute of them. Those which are there met with are very small, interlaced, and do not go to be inserted into the valves, like the principal ones of those met with in the auricular portions.

"The muscular fibres of the heart unite in fasciculi, and form in the interior of the cavities of that organ what anatomists and physiologists call *the fleshy columns of the heart,* which differ according as they are examined in the auricles or the ventricles, or even in each of these cavities individually. It is thus that they are much more marked in the ventricles than in the auricles; that they are more numerous in the right, than the left ventricle, although those of the latter are more voluminous than those of the former; it is thus also that the right auricle is provided with them to a considerable extent, whereas the left auricle contains none except in its appendix.

"Certain carneæ columnæ, crossing one another in all directions, give to the internal surface of the ventricles the aspect of a kind of net, the meshes of which are of different diameter and the threads of different thickness.

"Some of these fleshy columns, unconnected with the heart throughout their middle portion, are only attached to it by their extremities, and by their contraction act like the string of a bow.

"Other of these fleshy columns, only free at one of their extremities, give rise to a number of small tendons (chordæ tendineæ), which go to be inserted into the free edge of the auriculo-ventricular valves."

Professor Bouillaud is the first who has described with particular exactness the fleshy columns, which he considers as veritable special muscles, whose office it is to raise the valves, after they have been depressed during the diastole of the ventricles, and thus effect the occlusion of the orifices.

"Two carneæ columnæ, projecting in the interior of the left ventricular cavity, sometimes as large as the little finger, rise by numerous fasciculi from the posterior paries of the ventricle, the one outwards, towards the junction of the anterior surface of this cavity with its posterior surface, to form the left border of the heart; the other inwards, a little on this side of the sinus, where the posterior surface of the ventricle goes to be continued with that formed by the interventricular partition. After having as it were taken root not far from the apex of the heart, the two columns which we describe take their direction from below upwards, and when arrived at nearly half the height of the ventricular cavity, they become completely detached from the paries from which they sprung, and terminate by a soft, rounded extremity; the remarkable and almost constant disposition of which has not been mentioned by any anatomist.

This extremity is divided into several fasciculi, which afterwards unite so as to compose but two or three principal bundles; these by turning form a circle incomplete, that is to say hollowed on the side towards which the two columns are reciprocally turned. Of the two bundles which we have just described, the one is anterior or superior, the other posterior or inferior; each posterior bundle is a little shorter than the corresponding anterior bundle, and is also somewhat smaller. From the anterior bundle of each column arise several tendons, which go to be inserted into the anterior lamina of the bicuspid valve; they arrive there in the direction of radii, or like the folds of a fan. From each posterior bundle other tendons arise, which proceed likewise in a radiated direction, to be fixed to the posterior lamina of the bicuspid valve. The angles formed by the reunion of the two laminae of this valve receive likewise tendons, so that all the elliptical circumference of the valve is provided with tendinous fillets, which are subdivisions of those which we have mentioned as arising from the extremity of the double terminating bundle of each column.

"At the part where the two columns terminate by separating into bundles, as we have mentioned above, they leave between them, when the cavity of the ventricle is dilated, an interval of eight, ten, or twelve lines; whence it follows that, in this point, the tendons of these columns are at a considerable distance from one another, whilst, by reason of their reciprocal convergence towards the middle of the border of the lamina of each valve, they quickly approach one another, and their sides nearly touch at the point of their common insertion. It results from what we have just said, that nothing is more regular than the manner according to which the mitral valve receives the tendinous fillets of the anterior lamina, whilst those of the posterior lamina are sent to it from the bundles of the columns described, and in all cases each of these columns is inserted into only the half of the corresponding double lamina of the valve.

"The right column, as also the tendons which arise from it, are in general a little more voluminous than the left column and its tendons. I have two or three times tried to count the tendinous fillets, with which the mitral valve is furnished, I found their number to be about twenty-five. . . . . . .

"There arises also from the sides of the columns which we are describing, and from some other much smaller columns, traversing in different directions the ventricular surface, a certain number of fine tendinous fillets, the insertion of which takes place, not at the mitral valve, but at the ventricular parietes themselves.

"In the interval which separates the two *levator* muscles of the bicuspid valve, there exist some fleshy bundles passing transversely from one to the other, and which seem destined to bring them together, or at least to keep them in their position. . . . . . .

"Besides the two principal columns which we have described, you find in certain subjects some others much smaller, which go to be inserted by tendinous fillets into the contour of the mitral valve; but even in these cases the columns of this latter kind do not seem really to be any thing else but *adjacent appendices* of the two principal ones. . . . . . .

"When the two laminæ of the bicuspid valve are depressed and separated from one another as much as possible, as is the case when the blood penetrates from the auricle into the ventricle, the fleshy columns, which are there attached in the manner mentioned above, have evidently for effect, by contracting during the systole, to redress the depressed laminæ of the valve, since they draw them at all points, from the circumference to the centre. It is then with reason that I have thought proper to design these muscular columns under the name of *tensor, elevator,* or *adductor* muscles of the mitral valve. In consequence of the movement of approximation which these columns impress upon the opposite laminæ of the bicuspid valve, the left auriculo-ventricular orifice is exactly, and as it were hermetically closed.

"The laminæ of the valve once thus drawn together remain immoveable during the whole of the time that the contraction of their columns lasts, and cannot be either overturned or depressed upon the parietes of the auricle by the effort of the blood which presses on all sides the contracted ventricle.

"Besides, when the levatores of the mitral valve contract, their corresponding surfaces in some sort approach; in fact, during this contraction, all the left or auricular half of the left ventricle is almost completely obliterated; whereas the other half launches into the aorta the column of blood which it has received from the left auricle.

"This portion is then a sort of sinus which leaves a passage to the blood during the dilatation of the ventricle, and which closes during its contraction, by the mechanism explained above. It is in the interval which separates the two principal fleshy columns destined to above the bicuspid valve, that there exists, as has been already mentioned, the communication of this portion of the ventricle with the aortic portion.

The fleshy columns of the right ventricle are more numerous but less voluminous than those of the left; they do not take exactly the same direction, nor have they the same arrangement. Those which go to be inserted by their tendons into the free edge of the tricuspid valve are more than two in number; amongst them you remark three principal ones. They are not divided at their extremity, like those of the left ventricle, into bundles which distribute their tendinous fibres to the two opposite laminæ of the valve. The tendons of these three principal columns take the same divergent direction as those of the columns of the left ventricle.

Besides the tendons furnished to this valve by the three columns already mentioned, it receives others from small columns dispersed here and there at the surface of the ventricle; there are others also which arise immediately from the parietes of the ventricle, quite close to the circumference of the right auriculo-ventricular orifice.

Moreover the columns which thus send tendons to the tricuspid valve have evidently the same functions as those which act in an analogous manner with regard to the bicuspid valve; they constitute really *levator* or *tensor* muscles of the tricuspid valve. These muscles by contracting when the three laminæ of this valve are depressed, draw them from the circumference to the centre at all the points of their contour, and by this mechanism the right auriculo-ventricular orifice ought to be exactly closed. The columns and their tendons prevent the valve, when it is once thus redressed, from being depressed on the side of the parieties of the corresponding auricle."

We close here the description of the centre of circulation; the notions which we have given are sufficient for the comprehension of the phenomena of auscultation presented by the action of the heart. We think that our readers will approve our judgment in having given the above passage verbatim from the excellent work of Professor Bouillaud, and particularly the description of the mechanism of the play of the valves, which has so important a part in the formation of the noises of the heart.

Physiology of the Heart.

The action of the heart, like that of every muscular organ, consists essentially in movements. Its movements, the causes of the noises which we are going to study, are those of a double pump sucking up and discharging, which distributes over the whole body the nourishing fluid.

The movements are of two kinds—

The first are manifest to the touch and inspection of the heart outwardly; they are the alternate contraction and dilatation of the ventricles and auricles, or of the reservoirs and chambers of the pump.

The second are hidden, and only take place in one part of the cavities of the heart: it is the play of the valves, which are true organised suckers of this beautiful living machine. They accompany the ventricular movements, of which they are but the consequence; M. Bouillaud calls them *mouvemens valvulaires*.

It is during the time that these different movements are executed that you hear the double noise of the heart, analogous to the tic-tac of a watch or the *claquement* of the suckers of a pump in action. These noises are called *valvular noises* (*bruits valvulaires*) by the professor just mentioned.

The name of *systole* is given to the contraction of the ventricles and auricles, and that of *diastole* to their dilatation.

It is by these movements that the ventricles fulfil the office of the chamber of the pump (*corps de pompe*) and the piston.

The movements of the auricles are only slightly sensible, and are not propagated to the other parts of the heart, whereas those of the ventricles are very energetic, and cause a real locomotion of the organ; and thus it is only to these latter that allusion is made when it is said that the heart is in repose or in motion.

But the principal of these movements is without contradiction the systole of the ventricles, and principally of the left ventricle; it constitutes the active state of the heart, and is accompanied by a phenomenon not presented by the other three, which is the shock or impulsion of the point of the heart against the parietes of the chest between the fifth and sixth ribs. It produces a quivering in the precordial region which is sensible to the touch.

During the diastole the heart retires from the parietes of the chest.

These four movements of systole and diastole follow one another and recur periodically; each series of which, or, so to speak, each revolution of the heart offers therefore one contraction of the ventricles, and one impulsion of the apex of the heart against the parietes of the chest. You count the revolutions by the impulsions, as you might have done by any other one of the movements, if it had been perceptible in the precordial region. You can equally count the impulsions of the point of the heart against the parietes of the chest by the arterial pulsations with which they coincide.

The valvular movements consist in the successive depression and elevation of the auriculo-ventricular and arterial valves during the systole and diastole of the heart.

The movements of depression and elevation of the first coincide with the inverse movements of the second.

After having examined each movement in particular, and, so to speak, in detail, we will examine in what manner they are connected with one another.

All these phenomena are subordinate to the contraction and dilatation of the ventricles, in the same manner as in a pump the depression and elevation of the piston determine all the other movements.

The following are the principal effects of the systole and diastole of the ventricles.

Diastole of the Ventricles.—The ventricles, by dilating, draw the blood from the auricles into their cavity, and the blood cannot pass from the auricles into the ventricles without the auriculo-ventricular valves being depressed. The afflux of blood, by producing the distension of the ventricles, provokes their contraction.

Systole of the Ventricles.—The ventricles cannot contract without pressing on all sides the mass of the blood which distends them. This mass, seeking everywhere an outlet, tends to escape at once by the auriculo-ventricular and arterial orifices; but as the contraction has raised the auriculo-ventricular valves, the blood repulsed in this quarter is forced to escape by the arterial orifices, the valves of which it depresses. Once expelled, it cannot return into the ventricles, for in falling back from the arteries towards the heart it redresses the valves, and, if I may thus express myself, it shuts the door upon itself.

The movements of the auricles do not act a very important part in the discharge of the functions of the heart; their office is in a great measure that of a reservoir, which receives the liquid from particular pipes to transmit it to the chamber of the pump. Their systole is a fresh cause which favours the passage of the blood into the ventricles, but this movement is very feeble, as may be imagined from the absence of valves at the entrance of the veins into the auricles.

It remains for us now to recognise the order of succession in which the different movements of systole and diastole are executed.

The following are the results of experiments made by Dr. Hope upon frogs, rabbits and asses.

"After its movement of dilatation, the ventricle rests in a state of relaxation, which is regarded as the repose of the heart.

"The first movement of the heart which interrupts the interval of repose, is the systole of the auricle. This systole consists in a very slight and short movement of contraction, more considerable in the appendix than elsewhere, and propagated towards the ventricle by a sort of vermicular motion, the conclusion of which seems to be continuous with the systole of this ventricle.

"The ventricular systole commences suddenly, and is followed by the diastole. It is apparent to the view and touch, that the contraction of the ventricle consists in an energetical and sudden jerk, accompanied by the depression of the centre or body of the ventricle. The shock of the point of the heart against the parietes, and the pulsation of the arteries nearest the heart, are isochronous with the ventricular systole; the pulse of the arteries at some distance from the heart, as, for instance, the radial, follows the ventricular contraction at an interval scarcely perceptible.

"To the systole of the ventricles succeeds their diastole, during which they return, by an expansion instantaneous and sensible to the touch and sight, to the state in which they were during the repose. The movement of diastole is accompanied by a slight retraction of the auricles, and by the retirement of the point of the heart from the parietes of the chest; next comes the interval of repose, during which the ventricles remain in a state of plenitude without distension; after this repose commences, with the most perfect regularity, the series of movements mentioned above."

The whole of these movements, from the instant of the contraction of the auricles inclusively till the return of this same contraction exclusively, occupy about one second in the adult *.

As is evident, this space is divided into three periods.

The duration of each of these periods has been fixed as follows, by Laënnec, and verified by Dr. Hope.

1*st period*. Systole of the ventricles, half a second.

2*nd period*. Diastole of the ventricles, quarter of a second.

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* Less than one second in the healthy adult, the normal number of pulsations in this case being 75 in the minute.—*Note of Translator.*

3rd period. Interval of repose of the ventricles, the other quarter of the second [*].

We proceed to lay down the rhythm of the heart. By rhythm is understood,—

1. The relative duration of the successive pulsations of the heart.

2. The order in which each complete pulsation, or each revolution of the heart, presents the two movements of systole and diastole, and the repose of the ventricles.

3. The absolute duration of each complete pulsation.

4. The respective duration of each of the three periods, relatively with the total duration of a pulsation taken for unity.

Such are the different circumstances of the movements of the heart as far as the rhythm is concerned; they are far from being constantly the same; some of them vary according to the age, the sex, and the idiosyncrasy of individuals. Agitation, running, passion, impress on them also passing modifications. There are other derangements which are not observed, except in a morbid state, and it is only by auscultation that the majority of these latter can be discovered.

In order that the reader may be able more easily to embrace all the elements which may concur in the formation of the noises (*bruits*) of the heart, and discover the cause to which they belong, we will recapitulate all the principal phenomena produced by the discharge of the functions (*fonctionnement*) of the heart during each of the three periods which compose an entire pulsation, and assign to each of these periods those phenomena with which it coincides, or, in other terms, bring together all the synchronous phenomena.

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[*] According to this evaluation, there would remain no particular interval for the systole of the auricles, which Dr. Hope, notwithstanding, places separately. It is true, that he declares that this instant is short. But however short it be, since it precedes the contraction of the ventricles, and that the whole second is employed in their movement and their repose, its instant ought to coincide with the end of the time assigned to the repose of the heart.—*Note of Author*.

Duration of one pulsation, one second.

1*st period,* half a second.—Systole of the ventricles and diminution of the cavity of the ventricle.

Synchronism; sliding of the heart against the pericardium; shock of its point against the parietes of the chest; quivering of the parietes of the chest in the precordial region, sensible to the touch, the sight, and the ear; impulsion and friction of the parietes of the ventricles against the blood; collision of the particles of blood; elevation and tension of the auriculo-ventricular valves; impulse of the stream of blood against the auriculo-ventricular valves, and slight elevation of the redressed valves also against the sigmoid valves, and depression of these valves projected by the blood against the parietes of the arteries; expulsion of the blood by the arterial orifices and friction of the fluid against the inferior surfaces of their valves and the parietes of the arteries; arterial pulsation; diastole of the auricle during the first half of this period; state of relaxation of this part during the other half.

One of the noises of the heart coincides with this first half of the period of a pulsation.

2*nd period,* quarter of a second.—Diastole of the ventricle; enlargement of the ventricular cavity.

Synchronism; sliding of the heart against the pericardium; retirement of its point from the parietes of the chest (no shaking or quivering of the parietes is sensible); depression of the auriculo-ventricular valves afflux of the blood from the auricles into the ventricles; friction of the blood against the tendinous ring which borders the open orifices, against the superior surfaces of the depressed valves, against the ventricular parietes; collision of the particles of blood; closing of the arterial valves immediately after the contraction; re-action of the arterial parietes upon the blood expelled during the contraction and shock backwards of the blood against the sigmoid valves which it closes; state of relaxation of the auricles.

The other noise of the heart is heard during the dilatation: it is not separated from the first, except by an almost imperceptible interval of silence.

3rd period, quarter of a second.—Repose, or state of relaxation of the ventricles, followed towards the conclusion by the contraction of the auricles. Passage of the blood from the auricles into the ventricles; distension of the ventricles; occlusion of the arterial orifices.

Auscultation of the Heart in a healthy state.

Each complete pulsation of the heart presents therefore to auscultation two successive noises, one of which corresponds to the systole, the other to the diastole of the ventricles.

The nearest term of comparison that can be given to these noises is the *tic-tac* of a watch, or the double *claquement* of the sucker of a pump.

The *first noise* is generally dull, less striking, and more prolonged than the other. It is easy to recognise that it is isochronous with the impulsion of the point of the heart against the parietes of the chest, with the arterial pulsation, and consequently the systole of the ventricles *.

The *second noise*, shorter, but clearer than the first, corresponds to the diastole of the ventricle; Laënnec has compared it to the noise made by a dog lapping, and to the noise of the valve of a pair of bellows. In fact, its resemblance to the *claquement* of a sucker is greater than that of the preceding noise.

The tic-tac of the heart is heard much better in lean and nervous subjects than in fat and plethoric ones; but it is impossible to indicate all the shades of difference which it may present, according to the age, sex, idiosyncrasy, and state of calmness or agitation of different individuals: there are some of the shades which will not admit of a precise description, and which experience alone can appreciate.

When the pulse is quick, these two noises succeed one another with so great a rapidity, that they seem to resound simultaneously rather than successively; nevertheless they are not confounded, and the ear can always distinguish both sounds. If the pulse be slow, the ear may even detect a slight interval of *silence* which separates the two noises.

To this double noise succeeds a *silence*, longer than the first, corresponding to the repose of the ventricles. Like the first silence, this is longer in proportion to the infrequency of the pulsations.

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* If there exist any interval between the pulsation of the arteries at a considerable distance from the heart, and the noise in question, this interval is scarcely perceptible. Throughout, as we shall see, M. Pigeaux has maintained that the first noise, which he calls *bruit inférieur*, is isochronous with the dilatation of the ventricles.—*Note of Author.*

It is rare that the resonance of the noises of the heart is confined to the precordial region; in lean subjects, in those whose chests are narrow, and even in infants, these noises are heard in all the regions of the chest, even in the right posterior portion. They are even very well heard upon the lateral portions of the neck.

This transmission of sound takes place across the parietes of the chest, and the organs which they contain; if these different parts conducted the sounds equally well in all subjects, you might measure the intensity of the noises of the heart by the extent over which they were heard on the surface of the chest; but there are a number of circumstances independent of the heart, such as the leanness and embonpoint of individuals, or organic affections, which affect the capability of the organs for conducting sounds, and thus prevent us from taking advantage of this theoretical point of view.

The noises of the heart are sometimes elevated to such a degree of intensity in certain transitory palpitations, that you can hear them at some distance from the parietes of the chest.

In general, the noises of the pulsations of the heart diminish gradually in proportion as the examiner is removed from the precordial region. The first noise has its *maximum* of intensity immediately below and a little outside of the breast, in the point corresponding to the auriculo-ventricular orifices and valves; the other, on the contrary, is heard better above, and to the inside of the breast in the point corresponding to the sigmoid valves.

But the differences of density and elasticity of the chest in different points, rendering unequal the capability of its different parts for conducting sounds, frequently displace the seat of the maximum of intensity of the sound.

The quivering which the impulsion of the point of the heart impresses upon the parietes of the chest is sensible to the ear, like every movement which can be perceived by the touch.

Different theories have been proposed for the explanation of the normal noises of which we have been treating: we will state them briefly in the order of their antiquity.

First Theory.

The most ancient, that which is found in the works of Harvey, Senac, Haller, Bichat, and particularly Corvisart, attributes the noises of the heart to the successive contractions of its muscular fibres.

Laënnec embraced the received opinion, which appeared to him to be sanctioned by the experiments of Wollaston, and Dr. Erman, upon the noise produced by muscular fibres during their contraction.

The Author of Auscultation thought that the first noise depended upon the contraction of the fibres of the ventricles, and the second noise upon the contraction of the fibres of the auricles. Afterwards, the experiments of Dr. Barry having shown that the auricles are almost immoveable, and that they remain in a constant dilatation or plenitude, Laënnec had recourse to the contraction of the appendices of the auricles to account for the second noise of the heart.

According to Laënnec, the systole of the ventricles, the cause of the first noise, is the first movement.

The second movement is the ventricular diastole, which coincides with the systole of the auricle, the cause of the second noise.

Then comes the repose or state of inaction of the ventricles.

It would be too tedious to point out all the faults of a theory which only reposes on data altogether hypothetical.

The inductions of analogy are too deceitful, especially when they are not attached to other proofs.

And if it be not an abuse of analogy to induce from the noises of certain muscles during their contraction the noises of other muscles which do not admit of direct experiments, it is at least a misconception of the range of this kind of proof to admit the inductions without any other control.

In the second place, the muscles which yield noises during their contraction have never produced, according to the avowal of Laënnec, a phenomenon analogous to the tic-tac of the heart; it is a *rotatory noise*, analogous to that of a carriage rolling in the distance, as you may ascertain by applying the ear to the wrist and clenching forcibly the fist; or a *bruit de soufflet*, analogous to that presented by the heart and arteries in certain affections, and which may be observed by placing the ear upon a pillow and alternately contracting and relaxing the masseter muscles.

Second Theory.

Afterwards, M. Pigeaux advanced another opinion. According to this physician, the noises of the heart depend upon the shock of the blood against the parietes of this organ and the large vessels, and the contraction either of the ventricles or auricles is only a simple coincidence, and only concurs mediately to the formation of these noises.

The following, according to M. Pigeaux, is the order of the movements of the heart:—

The blood, arrived in the auricles, dilates them without noise, these then contract equally silently and launch the blood against the bottom of the dilated ventricles, the parietes of which vibrate and produce the first noise, called by M. Pigeaux *bruit inférieur* ("lower noise").

To the first noise succeeds a silence very short, having for its measure the instant of the contraction of the ventricles. The blood, driven from the ventricles by this sudden contraction, strikes the base of the pulmonary artery and aorta, and this percussion occasions the second noise, or *bruit supérieur* ("superior noise").

To the second noise succeeds the repose remarked by Laënnec, followed by the noiseless contraction of the auricles, with which the same movements recommence. This noiseless interval, which separates the noises of two pulsations, has been more exactly designated by M. Pigeaux under the name of *silence*.

The author advantageously combats the ancient opinion: analogy suffices for him to contest the formation of the noises of the heart by the contraction of its fibres, when the contraction of the most voluminous muscle, as the glutæus maximus, never produces a sound so high in the gamut as the noises of the centre of circulation.

On another hand, he adds, when the ventricles contract, the heart is filled with blood, and it is not either this reaction or the concentric shock of the parietes of the heart against the liquid it contains which is capable of producing an elevated sound. This conclusion is supported by the following experiment;—If you plunge the hand in a sonorous vase filled with liquids, the sudden and energetical contraction of the hand causes no noise; whereas the liquid which the hand may contain, being projected by jerks against the parietes of the vase, draws forth sounds from them.

It is then to the eccentric reaction of the interior liquid against the parietes of the heart that we must attribute the first noise.

To prove that the first noise is really formed in the bottom of the ventricles, and the second against the bases of the large vessels, M. Pigeaux maintains that the points, where the noises of the heart offer their *maximum* of intensity, are always at a distance of two or three inches from one another.

This circumstance is far from being constantly the case, as M. Bouillaud has remarked. It is known, besides, that these points can be displaced, be drawn nearer to one another, or separated farther off, according to the different capability of different parts of the chest for conducting sounds.

We might object to M. Pigeaux, that if the normal noises of the heart were owing to the cause which he assigns them, they would remain the same, or nearly so, or at least would not altogether disappear in important injuries of the valves.

Now, it is not so, says M. Bouillaud, indeed quite the contrary; for the injuries of which we are speaking, particularly different kinds of indurations of the valves, cause the normal noises of the heart completely or almost completely to cease, and occasion irregular noises, known under the names of *bruit de soufflet, de râpe, de scie, de lime, &c.* ("blowing, rasping, sawing, filing noise," &c.)

We do not wish to insist any longer upon the refutation by reasoning of a theory which is in contradiction with positive facts; for it is a positive fact, and easy to verify, that the first noise of the heart is isochronous with the ventricular systole.

Third Theory.

Dr. Hope, to throw light upon the subject of researches respecting the mechanism of the noises of the heart, has made several experiments upon different animals, and particularly upon asses.

He first commenced by depriving the animals of sensibility and movement by giving them a violent blow on the head, and afterwards carried on artificial respiration by means of a large bellows, the tube of which was introduced by an opening into the trachea.

After having taken this precaution for reducing and rendering more regular the pulsations of the heart, he sawed through the left ribs near the sternum, and laid them back in such a manner as completely to expose the centre of circulation.

The following observations were made by him:

1st. That the heart, distended or not, is always full.

2nd. That the auricles contract first, though scarcely over their fifth part, and that their contraction is propagated to the ventricles, so that the contractions of these two parts of the heart resemble rather one continuous movement than two successive movements.

The ventricle, which is continually full of blood, as we have already mentioned, becomes distended on receiving the fresh quantities which come to it from the auricles.

The distension of the ventricles quickly determines their contraction. Their contraction has for its immediate result the collision of the columns of blood and their breaking, which is additionally favoured by the inequalities of the internal surface of the ventricles. It is to this collision of the columns consisting of the particles of blood that the first noise is due.

When the heart once contracted returns upon itself, the blood falls from the auricles into the ventricles, strikes their parietes and produces the second noise.

Thus Dr. Hope assigns to the second noise the same cause as M. Pigeaux assigned to the *bruit supérieur.*

The idea of the formation of the first noise by the collision or the shock of the particles of blood is ingenious, and it seems to us strange that, after having admitted this principle, Dr. Hope should have searched for another cause of the second noise.

The reasoning of M. Bouillaud against the hypothesis which attributes the formation of the first noise to the fall of the blood from the auricles into the ventricles, maintains the whole of its force against that which places the formation of the second noise in the same movement. It refutes equally well the hypothesis of the formation of the first noise by the collision of the particles of blood *.

We have set forth above the result of the direct experiments of Dr. Hope upon the rhythm of the heart.

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* Journal Hebdomadaire, tom. ii. Nº 25, année 1834. Recherches expérimentales sur les Bruits du Cœur; by Dr. Hope, with notes of M. Bouillaud.

Fourth Theory.

Nearly about the time that the English physician published his researches upon the heart, M. Marc d'Espine proposed a theory altogether analogous to that of Laënnec.

M. Marc d'Espine finds in the mere action of the muscular parietes of the ventricles, during their movement of contraction and dilatation, the solution of the problem of the noises of the heart, which Laënnec attributed partly to the auricles, partly to the ventricles.

The researches of M. Marc d'Espine upon the rhythm have brought him to the same results as Dr. Hope.

Fifth Theory.

Another theory widely propagated at present is that of M. Magendie. This noted physiologist pretends that the first noise results from the percussion of the thoracic parietes by the point of the heart during the contraction of the ventricles, and the second from the percussion of the same parietes by the anterior surface of this organ during the dilatation of the ventricles.

The author alleges in favour of his theory:—

1. That, in the cases of considerable effusions in the cavity of the pericardium, when the thoracic parietes are separated from the centre of circulation by the liquid, you do not hear the noises of this organ.

2. That, in considerable hypertrophy of the heart, these noises are not heard, because the heart has not sufficient room to strike against the chest.

3. That, by removing the sternum in animals, you cease to hear the noises of the heart.

These facts, if incontrovertible, would render the refutation of this theory difficult; but they contain at least many exaggerations.

We have very often had occasion to see pericarditis accompanied with effusion, and yet the noises of the heart were always sensible, although a little more dull than in the healthy state.

We have found the same in considerable hypertrophies; and if in these two cases the noises be a little more dull than in the healthy state, the difference depends upon this, that they are stifled by the presence of liquids, or by the thickness of the parietes of the ventricles.

We are far from denying that the sonorousness of the surrounding parts of the heart has a great influence upon the resonance of its noises, or that it may even, in certain cases, cause anormal noises, of which we will cite an example.

Therefore, in animals of small stature, when these noises, although already strengthened by the adjacent parts, are only feebly heard, it is not astonishing that these noises disappear after the removal of the sternum.

However, the experiments of M. Bouillaud have taught him that this disappearing of the noises is only an illusion. This celebrated Professor has distinctly heard the noises of the heart in a cock and two rabbits, after having removed from them the sternum.

We have equally succeeded, together with M. Descleaux, in observing them quite lately on a rabbit, although we failed in our attempt a year ago upon a cat. Dr. Hope has been able to verify them upon five asses, which were the objects of his experiments.

To these facts, which directly attack the basis of the theory of M. Magendie, we will add an observation, which peremptorily destroys it. It is the following:

It has several times happened to us to hear, besides the two normal noises of the heart, a third noise arising from the percussion of the thoracic parietes by the point of that organ; it is not unfrequently met with in lean persons.

The latter noise, which we shall mention hereafter under the name of *tintement metallique*, is essentially different from the normal noises of the heart; and if it be incontestable that it is owing to the percussion of the chest by the point of the heart, you cannot assign the same mechanism to noises of an altogether different nature.

Sixth Theory.

A sixth and last theory has been quite recently proposed by M. Rouanet.

The following are, according to this physician, the rhythm and mechanism of the noises of the heart *:—

First period, contraction.—Immediately as the ventricle begins to contract, the blood pressed on all sides redresses the large valves, which are struck by their opposed surface. (The first noise is produced.) It raises the sigmoid valves, escapes into the large arterial trunks, which it redresses, and into all the arteries, which it distends; hence the shock of the heart against the thorax and the pulse.

Second period, dilatation.—The contraction is scarcely terminated before the dilatation commences; a vacuum tending to take place in the ventricle, there is aspiration upon the two orifices; the arteries distended re-act upon the blood, which returns briskly against the sigmoid valves. (The second noise is produced.)

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* Analyse des Bruits du Cœur, Thèse soutenue par la Faculté de Médecin de Paris; par M. Rouanet, en 1832, N° 252.

In the same period, the large valves are opened by the blood coming from the auricles. The ventricle is filled.

"The first noise," says M. Rouanet, "is heard at the commencement of the ventricular contraction. It is this which has caused the belief that this contraction was the cause of it. This noise is loud; it is in proportion with the energy of the ventricles; it is duller than the second; the valves which produce it are larger, the parietes which receive it are also thicker.

"The second noise is more distinct, because the valves are smaller, thinner, and attached to more sonorous parietes."

The shock, in the sense generally attributed to this word, and which results from the collision of two bodies, cannot be, according to M. Rouanet, the only cause of the noise of the valves. Numerous experiments have shown him that every membrane, passing from flaccidity to sudden distension, always yields a sound, which varies according to the circumstances. Its force is in proportion to those which distend the membrane, its éclat augments with the fineness and resistance to extension of the tissue of which it is composed; the largeness, thickness, and extensibility of the membrane, render the sound more dull. The auriculo-ventricular valves unite the most favourable conditions for the production of noise. They are thin, resistant, inextensible; they pass in an instant from the most complete flaccidity to sudden and violent distension, the result of the expulsion of the blood, and of the tension of numerous tendons, which, from their ventricular border or surface, go to be attached to the summit of several fleshy columns. Consequently, whether we consider in the valves one surface which goes briskly to strike against another surface, or whether we see therein an eminently sonorous membrane subject to a strong and instantaneous tension, we shall be forced to allow that there is there a noise perceptible to the ear."

The exposition of the theory of M. Rouanet, is the best refutation that can be given of the preceding theories.

In fact, of all the movements which take place in the play of the heart, that of the valves is, without contradiction, as fit to produce a noise as any previously brought forward.

This fact is proved, both by the experiments of M. Rouanet and by those which we make every day with pneumatic or hydraulic pumps, the play of which offers so great an analogy with that of the heart.

On the one hand, the particular nature of these noises bears such a resemblance to the *claquement* of suckers of different machines, that Laënnec, whose opinion cannot be suspected in this case, has compared one of them to the noise of the valve of a bellows.

On the other hand, neither the muscular contractions or dilatations, nor the flow of blood from the auricles into the ventricles, and the friction of the stream of blood against the parietes of the large vessel, nor the collision of the particles of blood, nor the percussion of the point or the base of the heart against the parietes of the chest; none of these circumstances, I say, are fit to produce noises, nor would they produce the double *claquement* of the valves or the tic-tac of the heart.

But does not the pathological physiology of the heart give us a direct and irresistible proof of the noise of the valves? M. Bouillaud, in his work not yet published, has the following passage:—"As long as the valves are capable of playing freely, whatever be the maladies of the heart, they are not accompanied by a profound and radical alteration in the noises of the heart; there ensues only an augmentation or diminution, more or less considerable, of these noises. If, however, the alterations of the heart be such that the valves cannot play properly; if, for instance, these alterations affect, as is so frequently the case, these organised suckers themselves, in these cases you will immediately observe constant and profound alterations in the noises of the heart; and they will even sometimes entirely disappear and be replaced by others, such as the *bruit de soufflet, de scie, de râpe, de sifflement.*"

The theory of M. Rouanet, by showing under the same point of view the production of the normal and abnormal noises, and by bringing together as much as possible the mechanism of one and the other, offers an unity and extent as satisfactory for the mind as useful for practice. Therefore we particularly propose this theory to the consideration of practitioners, in whom it should inspire the more confidence, inasmuch as it is professed by M. Bouillaud, whose researches on diseases of the heart are so excellent and so generally known.

However, this celebrated practitioner thinks that M. Rouanet has shown himself somewhat exclusive in referring the first noise solely to the play of the auriculo-ventricular valves, and that in the formation of the first noise of the heart, we should equally take into account the sudden projection of the sigmoid valves against the parietes of the aorta and the pulmonary artery.

So also for the second noise, M. Bouillaud is inclined to think that the sudden depression of the auriculo-ventricular valves, which takes place at the same time as the occlusion of the sigmoid, is not altogether foreign to its formation *.

M. Piorry has likewise made several experiments for the purpose of explaining the mechanism of the noises of the heart. This practitioner says that he has distinctly heard these noises, by making a current of water pass into the cavity of this organ, after having cut off the valves; and he concludes from these experiments that the intensity, and perhaps the nature of the noises produced in the heart, arise from a variety of principles:—

1. The force and rapidity with which the blood is propelled.

2. The density of the substance of the heart.

3. Dimension of the orifices.

4. Diminution of the cavity by which the blood passes.

5. Hardness of the heart which contracts.

6. The diminution which the contraction of the fleshy fibres may determine in the kind of tube formed by the heart, and the passage of the blood through this organ.

We content ourselves by giving the simple exposé of these facts.

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* Traité clinique des Maladies du Cœur, en 1835, pp. 135 et 136.

AUSCULTATION OF THE HEART IN A MORBID STATE.

Abnormal noises.

If the play of the valves be the cause of the normal noises, it is evident that the injuries which attack the conformation of these parts, or modify their play, will also affect the noises of the heart. On the other hand, if the movements isochronous with the play of the valves, such as the gliding of the heart against the pericardium, the striking of its apex against the parietes of the chest, the flow of the blood against the parietes of the ventricles, and against the surfaces of the valves; if all the movements, I say, be noiseless in a healthy state, they nevertheless contain the elements of noise; and these elements may be completely developed in the injuries, whether organic or physiological, of the centre of circulation, and produce new noises in the precordial region.

Finally, the retrogradation of the blood from the ventricles into the auricles, and from the arteries into the ventricles (which movement does not exist in healthy state, but which is the result of certain injuries of the valves), may produce abnormal noise, as the other movements of the blood do in analogous injuries of the centre of circulation.

We shall presently see that all these inductions are verified; but let us first examine the simple modifications of the noises of the valves.

It would be difficult, or rather impossible, precisely to determine the different normal and abnormal modifications of the noises of the valves, whether as respects their intensity or their tone.

Nothing varies so much as the *intensity* of these noises; sometimes they are so intense that they imitate the distant clack of a mill, and can be heard at a distance; in other cases they are so slightly marked that they can be only distinguished by great attention.

In general, the noises of the heart are more intense in proportion as the force with which the valves and the ventricles move is more considerable, and the tension of the valves augmented, and as their density, and consequently that of the parietes of the ventricles, is less.

The noises of the valves offer sometimes a remarkable character, viz. a parchment-like tone (*timbre parcheminé*) analogous to the dry, harsh, and distinct clicking sound (*claquement sec, dur et clair*) of two sheets of parchment forcibly and briskly clashing against one another, and which, in the opinion of M. Bouillaud, coincides with a state of hypertrophy accompanied with rigidity of the valves.

At other times, on the contrary, the noises of the heart are as it were rough, harsh, stifled (*âpres, enroués, étouffés*). According to the observer from whom we borrow these details, this latter tone would coincide with a state of flaccidity of the valves, and is only an inferior degree of the *bruit de souffle,* the appearance of which it frequently precedes, or follows. M. Bouillaud has moreover observed that whenever this noise *changed to* the *bruit de souffle,* it was owing to certain incrustations or vegetations on the valves.

But in all the modifications which we have cited, as in all those which do not hinder the tic-tac of the valves from being heard, you can ascertain that the injuries of the valves do not prevent their free play.

And reciprocally, whenever the injuries of the valves do not affect their movement, the noises of the valves will never be completely obliterated.

The abnormal noises, of which the formation is not incompatible with the free play of the valves, may therefore exist in the precordial region at the same time as the normal noises.

But as soon as the injuries of the valves prevent their free movement, the normal noises will cease to be heard, and will be replaced by others.

1. The abnormal noise which most frequently replaces the tic-tac of the heart is the *bruit de souffle,* the appearance of which frequently even precedes the extinction of the noises of the valves.

The *bruit de souffle,* properly so called, is only a variety of the generic *bruit de soufflet* of Laënnec; the other varieties observed by this author, are the *bruits de scie and de râpe* ("sawing, grating noises"). All these noises have as a common character the real *souffle* ("blowing noise"). It is the same with the *bruit sibilant* (sibilus), observed by M. Bouillaud, who only regards it as a more acute degree of the *bruit de soufflet,* and who makes the same distinction between them as between souffler and siffler ("to blow and to whistle").

The *bruits de souffle, de scie, de râpe,* and the *bruit sibilant,* are easily imitated by expelling the air with more or less force from the mouth half opened.

There is, however, one species of the *bruit de soufflet* which resembles the noise accompanying the inspiration of a small column of air rather than its expiration.

What is the cause of these different abnormal noises?

Laënnec, who only took the absolute measure of the orifices of the heart, and who had frequently observed the *bruit de souffle* in cases where the absolute diameter of the orifices remained normal, was led to the conclusion, "that the abnormal noises are not dependent upon any organic injury in which you can find their cause."

The author of auscultation, in wishing afterwards to explain the *bruit de soufflet* by a simple spasm, did what is done by many practitioners even at present, when they attribute to a nervous state any affection of the nature of which they are ignorant.

If the organic dispositions and physiological conditions of the heart have furnished us with the physical causes of the noises of the valves, let us not search elsewhere than in organic and physiological affections the reason of the abnormal noises.

A noise, a vibration, supposes two principles: 1st, the *instrument* of vibrations, or the element which vibrates; 2nd, the *agent* of vibrations, or the moving power which provokes them.

The parietes of the heart, and particularly of the valves, perhaps also the blood, form the principal instrument, the principal seat of vibrations.

Hence it follows that every important modification of the conformation of the heart and of the movement of the blood, necessarily affects the noises of the heart.

This has been proved by M. Bouillaud by the most positive facts.

It results from the labours of this able professor, 1st, that if the organic stricture of the orifices be not the sole injury which can occasion the *bruit de soufflet*, it is at least the most frequent cause; insomuch that out of twenty cases where this noise is observable, nineteen of them will present stricture.

2. That in all cases the *bruit de souffle* may be attributed to one and the same condition, viz. increase of friction (*surcroit de frottement*) during the passage of the blood through the orifices and cavities of the heart.

It is thus that you produce the *bruit de soufflet* in an artery by compressing it somewhat forcibly, so that it may experience a more considerable friction during the passage of the blood.

You will therefore hear the *bruit de soufflet* in all affections, whatever they be, which may have for their result the augmentation of the friction of the column of blood against the parietes of the orifices or the ventricles.

The following are the different kinds of affections in which M. Bouillaud has heard the *souffle*:—

1. When there is coagulated blood in the passage of the blood, whether in the orifices or even in the ventricles.

2. In the cases of stricture of the aortic orifice, whether congenital or produced independently of the state of the valves.

3. In the cases where, without stricture of the orifices, the valves, covered with vegetations or calcareous or cartilaginous incrustations, present an unequal surface, or, when only flabby and incapable of exactly shutting up the orifices: first case of insufficiency.

4. In two cases, where, without stricture of the corresponding auriculo-ventricular orifice, the auriculo-ventricular valves had adhered to the adjacent parietes, which adherences preventing their free play, would produce a second case of insufficiency.

5. In certain cases of dilatation of the auriculo-

ventricular orifices accompanied with dilatation of the ventricles; third case of insufficiency.

6. Sometimes, but not in a permanent manner, in cases of considerable hypertrophy of the left ventricle, with dilatation of its cavity. It is after fatigue and moral emotions that the *bruit de soufflet* is the most distinctly heard in the latter case.

7. Sometimes in nervous persons, or in those affected with chlorosis, the *bruit de soufflet* coincides with attacks of palpitation.

8. In cases of copious hæmorrhage.

Finally, you may admit theoretically the possibility of the formation of the *bruit de soufflet* in cases of compression of the heart, caused by effusion in the cavity of the pericardium or by any tumour whatsoever.

It is evident that in all these cases, the affection produces an increase of friction.

In the two first cases this increase is evident. In the third and fourth cases, the valves, not being able to close exactly their orifices during the dilatation, by reason of the inequality of their surface, permit the blood to flow back from the ventricles into the auricles, and this reflux through a narrow orifice would naturally produce more or less considerable friction.

It is the same in the fifth case, where the circumference of the dilated orifices would draw outwards the base of the valves, and would no longer permit them to cover completely their orifices. In that case, the blood flowing back from the ventricles into the auricles by the narrow orifice comprised between the free edges of the valves, would produce friction sufficiently considerable to occasion the *bruit de soufflet*.

In the sixth case, the heart does not present any organic affection; but the energy of the contractions of the ventricles, and the proportionate force with which the blood is propelled against the orifices, are sufficient to account for the increase of friction.

The *souffle* in persons affected with chlorosis enters into the fifth category. In fact, nothing is more frequent in this affection than to find dilatation of the ventricles accompanied with diminution of the density of the parietes.

Finally, M. Bouillaud attributes the *bruit de soufflet,* which is heard after copious hæmorrhages, "to the convulsive vivacity with which a small column of blood is expelled by the heart through a cavity and orifice, become very narrow, on account of the retreat of the heart upon itself, so as, as it were, to accommodate itself to the small quantity of blood which it receives."

It is very certain, then, for us of the present day, that the *bruit de soufflet* does not depend upon one and the same affection; that many anatomical, or even purely physiological conditions may occasion it, provided that the conditions be capable of producing an increase of friction, which is the common element of all these noises.

But among these different conditions, there are some which only occasion certain and invariable species of the *bruit de soufflet.* Thus, observation has discovered, that it is solely in the cases of stricture of the orifices of the heart, occasioned by induration of the valves, that you hear the *bruits de râpe, de scie* and the *sifflement* or musical sibilus. On the contrary, the *bruit de souffle* may be heard in all the affections which we have mentioned.

When the *bruit de souffle* accompanies an organic stricture of the orifices, this stricture coincides (as Laënnec has already remarked) with an induration of the valves, rather fibrous or fibro-cartilaginous than osseous, with a smooth rather than a rough state of the surface of the valves, with a slight degree of stricture, and with contractions and dilatations of the ventricles of moderate force rather than with energetic movements.

The conditions of the *bruits de scie* or *de râpe* are just the reverse. These noises are heard principally in the cases of considerable stricture of the orifices, and coincide with the rough state of the surfaces of the valves, and with energetic movements of the heart.

These latter noises are the resonance either of vibrations excited in the rough parietes during the passage of the blood, or of vibrations excited by the column of blood itself as it breaks against the uneven surfaces.

The *bruit de sibilant* or sibilus, which, as we have already said, is only a sharper tone of the *bruit de souffle*, ought also to depend upon a stricture; one, however, more considerable than that which accompanies the other varieties of the *bruit de soufflet.* In fact, in one case, where M. Bouillaud very distinctly observed a *sifflement,* he found at the autopsy so considerable a stricture of the left auriculo-ventricular orifice, that it resembled a slit, having no more than three lines in extent in its greatest diameter.

We would here observe, that it is impossible in a healthy state to distinguish the noises which belong to the left half of the heart from those which are produced in the right half, and, consequently, to assign to the resonance of each of them a particular place in the precordial region.

But if an abnormal noise have its *maximum* of intensity below the nipple, there will be a presumption that this noise belongs particularly to the left ventricle ; the contrary is the case if it be heard best upon the sternum. However, this observation, which is far from being always verified, is not always applicable. In fact, the majority of injuries of the valves and the orifices are followed by hypertrophy of the ventricles ; and as, in the case in question, the primitive injury and the consecutive hypertophy occupy only one ventricle, the normal ventricle will be as it were enchased in the other ; so that all the noises which may be heard, either under the papilla or upon the sternum, will belong to this latter, and will offer no sensible difference between them.

Is it possible to recognise whether an abnormal noise belongs to an affection of the auriculo-ventricular orifices and valves, or to that of the arterial valves ?

According to M. Rouanet, the observation of the rhythm of the heart, and the determination of the parts of the precordial region, where the noises of this organ are the most distinctly heard, will give more or less presumption on this subject ; for if the abnormal noise be heard during the contraction of the ventricles, there will be a probability that the aortic orifice is affected. This presumption will be corroborated if the abnormal noise be heard towards the region of that orifice

However, the *souffle* occasioned by the reflux of the blood into the auricles, accompanies likewise the contraction of the ventricles ; but in this latter case, M. Rouanet asserts that the abnormal noise will be heard more distinctly towards the point of the heart, than towards the aortic orifice.

If the abnormal noise accompany the dilatation of the ventricles, it is probable that one of the auriculo-ventricular orifices is affected, and that the abnormal noise is owing to the passage of the blood through this affected orifice.

But the same movement of the heart may be accompanied by another abnormal noise, arising from the insufficiency of the sigmoid valves; however, by taking care to mark attentively the place where this noise has its greatest intensity, you will be able, up to a certain point, to determine that of its origin, as in the preceding case.

On the other hand, M. Bouillaud asserts that the *souffle* which is occasioned by the reflux of the blood through an orifice incompletely closed, offers this particularity, that it takes place singly, either during the dilatation of the ventricles, and when the sigmoid valves are the insufficient ones, or during the systole of the ventricles, when the insufficiency is in the ventricular valves; whereas the *bruit de soufflet* is frequently double in the cases of organic stricture of an orifice.

II. Besides the abnormal noises which we have passed in review, you will sometimes hear in the precordial region other noises, which are not formed in the interior of the heart, but between the laminæ of the pericardium.

Bruit de frôlement (" rustling noise"). This noise resembles that obtained by the rustling of silk or taffeta.

It seems to take place immediately under the ear, and is diffuse: which distinguishes it from the *bruits de râpe* and *de scie*, which depend upon affections of the valves or orifices of the heart, and with which it might be confounded.

The *bruit de frôlement*, when it is very slight, seems to correspond, according to the facts observed by M. Bouillaud, to a peculiar state of the pericardium, where its opposite laminæ, "dry and somewhat viscous, as is the case at the commencement of pericarditis, are not yet lined with false membranes, or at least only begin to be so lined. Then these two laminæ, during the movements of contraction and dilatation of the heart, act in some sort with regard to each other like two pieces of silk or chintz, which you rub against one another."

Bruit de cuir neuf ("noise of new leather"). This noise, first observed by M. Collin, imitates perfectly the creaking of a new saddle. I have observed it once in the service of M. Bouillaud, and could not help admiring the just comparison of M. Collin. Its formation seems to me to depend upon the stretching of the dense and resisting false membranes during the movements of the heart. At least, such is the conclusion which might be drawn from the autopsy of the patient who presented this phenomenon.

Bruit de raclement ("raking, scraping noise").—M. Bouillaud gives this name to a noise which tolerably well imitates that made by the scraping of a very hard as it were cartilaginous or osseous body against the surface of the pericardium. The patient in whom M. Bouillaud observed the presence of this noise in the left portion of the precordial region, presented at the post mortem examination a calcareous concretion, which raised the visceral portion of the pericardium, exactly at the point corresponding to the portion of the chest where the *bruit de raclement* presented its maximum of intensity.

Bruits de souffle, de scie, de râpe. These noises already noticed in the affections of the heart itself, may also belong to affections of the pericardium. They are in the latter case produced by the friction of the two laminæ of pericardium, covered with false membranes, during the approach of the apex of the heart to the parietes of the chest.

You will produce analogous noises by rubbing the finger against a pane of glass somewhat humid.

The noises accompanying affections of the pericardium are distinguished from those which accompany injuries of the valves of the heart, by their being more superficial, and being heard over a more circumscribe space. The best idea of their difference is obtained by comparing the two in the same individual, when that is possible *.

The abnormal noises of the heart are isochronous with the movements of that organ, whilst the abnormal noises of the respiration coincide with the movements of inspiration and expiration.

3. Finally, we ought not to omit another noise which does not belong either to affections of the pericardium or the valves, and which has been known since the time of Laënnec under the name of *cliquetis métallique.*

This phenomenon, called *tintement métallique* ("ringing or tingling noise of metal"), results from the percussion of the parietes of the chest by the point of the heart during the systole of the ventricles.

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* I lately had under my observation a patient, twenty years of age, subject to a chronic affection of the valves, with a complication of pericarditis accompanied with false membranes.

On ausculting the region of the heart, I found two species of noises, one of which, the *bruit de souffle,* was profound, and corresponded to the region of the valves of the heart; the other, altogether superficial, imitated very well the noise of a saw, or the noise produced by two pieces of paper rubbed against each other. The autopsy has since confirmed the diagnosis. Besides the induration of and small vegetations upon the bicuspid valve, the visceral pericardium was covered with false membranes, soft and uneven, presenting in a great measure the appearance of the tongue of an herbivorous animal.—*Note of Author.*

It is heard principally in lean and nervous persons who have palpitations.

It may be very well imitated by applying the palm of one hand against the ear and percussing the back of this hand with the one which is free.

The *tintement métallique* does not prevent the two noises of the heart from being heard.

Abnormal rhythm.

The abnormal state does not merely alter the tone and intensity of the noises, but produces also a confusion in the rhythm.

This confusion consists, either in the *rarity* or *frequency* of the pulsations, or in their *irregularity*, or, finally, in their *intermission*.

It frequently happens that the movements of the heart are only accelerated or retarded, without the pulsations ceasing to follow one another regularly.

It is this which constitutes the *rarity* and the *frequency* in these cases; it is ordinarily the repose which is augmented or diminished.

The *irregularities*, or variations of frequency, take place when the pulsations of the heart succeed one another at intervals of unequal duration.

Sometimes they are constant.

Sometimes they only recur from time to time, and offer a sudden variation of one pulsation in the course of a series otherwise regular.

This sudden variation of a single pulsation differs from the *false intermission* in this, that the pulsation, though shorter, is not, however, more feeble than the others.

The irregularities most frequently affect the complete pulsations of the heart; but sometimes they only affect one of its movements.

Sometimes, in this extreme disorder, it is the first noise which is prolonged; sometimes it is the second noise which, stronger and more prolonged than ordinarily, seems to anticipate the first noise.

When the systole of the ventricles is extraordinarily prolonged, M. Bouillaud says that the pulsations of the heart appear to be spun out.

At other times you hear two or three noises isochronous with the dilatation of the ventricles, for one only of their contraction; these noises succeed one another rapidly, so that they imitate tolerably well the *bruit de rappel* ("repetition"), to which M. Bouillaud has compared them.

In other cases you reckon two or three systoles for one diastole.

I have verified some of these irregularities of which Laënnec speaks in his *Traité d'Auscultation*. Their production may be conceived in different manners, but it is difficult to assign them a precise cause.

Intermittence is the name given to a sudden and momentary suspension of the pulse.

Laënnec gives the name of *intermittences vraies* to those intermissions in which the contractions of the heart are suspended as well as the arterial pulsations.

This species of intermission is a real arrest, a hesitation of the heart, and resembles a prolonged silence, so that, if it alternated with each pulsation, it would not differ from the case of a slow pulse.

The *intermittences fausses* (false intermissions) coincide with feeble contractions, which are not perceptible in the arteries, but which can still be detected by ausculting the precordial region. Frequently even the pulse presents in this case, from time to time, a pulsation extremely feeble, instead of a total suspension.

The duration of the intermission is not the same in all cases; sometimes it equals that of an entire pulsation; at other times it is longer or shorter.

Its return also is not subject to a fixed law; in certain cases it happens after the second pulsation; in others, again, it is not till after the tenth.

But in a given case, this return is regular in its succession, and reappears constantly after the same number of pulsations.

M. Bouillaud assures us that he has observed a species of false intermission, coinciding with a ventricular contraction, which takes place, so to speak, empty. This movement constitutes, according to the expression of this physician, a kind of *faux pas* of the heart, and depends upon this, that the left ventricle, in which it is ordinarily observed, not having been able to fill itself sufficiently with blood during the systole (a circumstance common enough in the case of stricture of the auriculo-ventricular orifice), beats really if not altogether empty, at least upon a very small quantity of blood.

ARTICLE II.

AUSCULTATION OF THE ARTERIES.

On ausculting the arteries in the normal condition, you do not hear any other noise than that which proceeds from the shock of the column of blood against the parietes of the arteries. This noise, which is very dull, varies in intensity according to the volume of the artery, according to the force and rapidity of the pulse, the age of the subject, the sex, the constitution, &c.

It tolerably well resembles, as M. Bouilland says, the sound which is obtained by rubbing gently, but briskly, two fingers one against another.

It is the only noise heard in the arteries in a normal state; it corresponds to each systole of the ventricles, or to each diastole of the artery.

Great care should be taken not to consider as normal the slight *bruit de souffle* which accompanies each arterial pulsation whenever the artery is compressed by the stethoscope. This noise is only the exaggeration of the normal noise, owing to the augmentation of the friction of the column of blood against the parietes of the compressed artery. It is simple, isochronous with the systole of the heart, like the normal noise.

This *bruit de soufflet intermittent* ("intermittent blowing noise") may occur in the numerous affections where one of the large arteries is compressed. M. Bouillaud in one instance has observed it in the left iliac region in a female with a tumour in the left ovarium, which tumour compressed, more or less considerably, the iliac artery.

The other cases in which the *bruit de soufflet intermittent* has been observed, are:

1. The presence of an aneurismal tumour; pregnancy.

2. The presence of osseous or cartilaginous substances, with or without stricture of the arteries.

3. The passage of arterial blood in a vein (*aneurisma varicosum*).

4. Considerable agitation of the arterial system,

principally in thin persons, or those affected with chlorosis.

Ficher, an American physician, has lately read a paper at the Medical Society of Boston, in which he cites several cases where he says that he has observed the *bruit de soufflet*, by applying the ear to the head of individuals attacked with inflammation of the serous membrane of the brain.

He has given to this phenomenon the name of *bruit de soufflet encéphalique*.

I have not yet been able to verify this observation, which is an additional reason for bringing it before the attention of my readers.

Does its formation depend upon the compression of the vessels of the brain, as Dr. Ficher thinks? We do not think that any other reason can be assigned to it. This noise is considerably diminished, or even altogether disappears, when any obstacle is put to the circulation in the carotids; I should regard it as a case of the *soufflet intermittent* *.

Bruit de soufflet continu, et bruit ou ronflement de diable. ("Continuous blowing and snoring noise.")

M. Bouillaud has given the name of *soufflet continu* to a noise which is sometimes heard in the arteries, and which resembles tolerably well the blowing noise of the bellows of a forge. It accompanies the systole and diastole of the arteries; but although continuous, it presents successive reinforcements, which resemble sudden jerks. The reinforcement of this noise corresponds to the contraction of the ventricles.

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* The Medical Magazine, No. 15. Journal hebdomadaire des Progrès des Sciences et Institutions Médicales, tom. i. No. 4, en 1834.

The *bruit de diable* (noise of the humming-top), so called on account of its resemblance to a child's toy known under the name of *diable* *, is only a variety of the *bruit de souffle continu.*

Sometimes the noise of the arteries resembles rather the cooing of pigeons, or even the whistling of air through a key-hole, than the *bruit de soufflet continu.*

The *bruit de diable* is most frequently observed in the carotid and subclavian arteries; more seldom in the crural arteries, and never to the same degree as in the preceding arteries.

Sometimes it is heard on both sides. In this case, it is generally more feeble on one side than on the other; but most generally it is only heard on one side.

The *bruit de diable* disappears immediately on compressing the artery below the part at which it was heard. It also disappears by pressing the artery forcibly with the stethoscope, even although its calibre be not completely effaced.

But what is most remarkable is, that the *bruit de diable* frequently appears and disappears from one minute to another, without our being enabled to detect the cause of these alternations.

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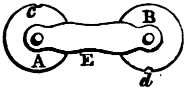
* This plaything is a double humming-top, or, as it is sometimes called, a double German top. It is of the following shape:



A and B are two hollow tops united at E; *c* and *d* two orifices for the admission of air. The instrument is put in rotatory motion by two sticks united by a string of a certain length, which passes by the point E, so that the instrument itself is balanced. As it turns, the air rushing in by the orifices produces the peculiar *ronflement* in question. —*Note of Translator.*

Sometimes the mere change of position of the patient is sufficient to produce these alternations.

Sifflement modulé, ou chant des arteres ("musical whistling, or modulation of the arteries"). Sometimes you hear a kind of tune in the arteries. The sound resembles sometimes the humming of certain insects. In one case in which I heard this noise, one would have said that it was that produced by a bee fluttering about in a silent spot *.

All these noises, with the exception of the *bruit de soufflet intermittent,* are principally observed in persons affected with chlorosis.

During a year and half that I have punctually attended the clinical visits of M. Bouillaud, I have observed more than thirty times the *bruit de diable,* and have not seen a single patient affected with chlorosis that has not presented it.

The frequent coincidence of these noises with chlorosis, would lead us to think that their production depended upon the bad composition of the blood peculiar to this affection. Experience corroborates this opinion. I have frequently had opportunity of observing this noise artificially produced after very copious blood-letting, and again disappear when the blood had regained its qualities under the influence of tonics.

Judging from the facts as yet observed, M. Bouillaud would be led to believe that the *bruit de diable* is most frequently met with in stout persons affected with chlorosis, whereas the *sifflement musical* is more frequent in thin and nervous persons affected with the same disease.

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* By making use of compression, the *ronflement* or *bruit de diable* may sometimes be changed into the *sifflement.—Note of Translator.*

What is the cause of all those abnormal noises which we have just mentioned?

The mere exposition of the cases in which the *bruit de soufflet intermittent* is heard, is sufficient to show its mechanism. Its essential element is friction (*frottement*), the same as in the *bruit de souffle* of the heart.

It is not so easy to explain the mechanism of the *bruit de soufflet continu.* However, if we observe accurately the state of the arteries in individuals who offer the different shades of this noise, it is impossible to mistake the modifications which take place in the tension and volume of the arteries, in the density of their parietes, as well as in the quality of the blood which traverses their cavities. And we know that all these modifications ought to influence the noises which accompany the passage of the blood in the arteries.

Perhaps, besides these general conditions, there may be other particular ones which cause these noises to be heard better in one artery than in another. Is not the presence of the larynx and the trachea a principal cause why the *bruit de diable* and its modifications are heard more distinctly in the carotid artery than elsewhere *? I am led to think so because this phenomenon may be suspended, as it were by enchantment, by ordering the patient to make an effort.

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* It may be well, however, to observe here, that the fact of the *bruit de diable* existing in the distant arteries, such as the crural, is a most valuable corroboration of the explanation of that sound in the carotids. For although the proximity of the lungs doubtless *modifies* the sounds formed in the carotids, yet the fact of analogous sounds existing in the crural arteries puts an end to the explanation of these sounds *arising entirely* from the proximity of the larynx and trachea. —*Note of Translator.*

ARTICLE III.

APPLICATION OF AUSCULTATION TO PREGNANCY.

The introduction of auscultation into medicine has discovered for the art of accouchement an invaluable sign of pregnancy.

For a long time the movements of the fœtus felt by the mother, the cessation of menstruation, united with the augmentation of the volume of the abdomen and the swelling of the breasts, &c., were regarded as the most undeniable signs of pregnancy. But tumours of different natures developed in the uterus or thereabouts may produce amenorrhœa, augment the volume of the abdomen, and cause the swelling of the breasts, which are connected by a most intimate sympathy with the uterus.

On the other hand, the pregnancy may date from nine months back without the mother having ever felt the movements of the infant; and again, hysterical females have felt movements analogous to those felt during pregnancy without ever being pregnant.

It was M. Mayor, a celebrated surgeon of Geneva, who first declared that the pulsations of the heart of the fœtus might sometimes be heard, but he did not prosecute his researches upon this subject, which M. le Jumeau de Kergaradec has had the honour to illustrate and develope.

According to this latter physician, when you auscult, either with the naked ear or with the stethoscope, the

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* It may be [illegible] that the [illegible] *bruit de diab*[illegible] [illegible]

ARTICLE III.

APPLICATION OF AUSCULTATION TO PREGNANCY.

The introduction of auscultation into medicine has discovered for the art of accouchement an irrefragable sign of pregnancy.

For a long time the movements of the fœtus felt by the mother, the cessation of menstruation, united with the augmentation of the volume of the abdomen and the swelling of the breasts, &c., were regarded as the most undeniable signs of pregnancy. But tumours of different natures developed in the uterus or elsewhere may produce amenorrhœa, augment the volume of the abdomen, and cause the swelling of the breasts, which are connected by a most intimate sympathy with the uterus.

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[illegible], when you auscult, [illegible] the stethoscope, the abdomen of a female arrived at the half of the term of her pregnancy, you can distinguish two noises :—

1st. A simple pulsation accompanied with a *souffle*, or the *bruit placentaire* ("noise of the placenta").

2nd. Double pulsation of the heart of the fœtus.

The first noise ought to correspond, according to this physician, to the insertion of the placenta, and depend upon the passage of the blood in the vessels of the placenta*.

Laënnec thought that this noise takes place in the uterine artery which serves for the nutrition of the placenta.

M. Ollivry, physician at Quimper, has ascertained four times that this noise ceases immediately as the umbilical cord is cut, and thinks that it corresponds perfectly to the insertion of the placenta†.

But the assertion of M. Ollivry is not conclusive. It does not speak more in favour of the opinion of Laënnec than that of M. Bouillaud.

This latter observer thinks that the *souffle of the placenta* (so called), which is but a case of the *bruit de soufflet intermittent* of the arteries we have just been speaking of, is the effect of the compression of one of the large vessels of the abdomen, such as the hypogastric and external iliac arteries, by the uterus charged with the produce of conception.

Laënnec thought that this opinion was inadmissible, because, said he, according to this hypothesis, you ought to hear the *souffle placentaire* on both sides of the uterus, either at the same time or alternately, and you might displace it at pleasure by varying the position of the patient.

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* Mémoire sur l' Auscultation appliquée à l'etude de la Grossesse;" by Le Jumeau de Kergaradec, 1822.—*Note of Author.*

† See the letter of M. Ollivry to Laënnec, in the Traité d' Auscultation of this latter author.—*Note of Author.*

But there are cases in which you really do hear the *bruit de soufflet* on both sides of the uterus at once.

On another hand, M. Bouillaud has succeeded in displacing the *bruit de soufflet* in a pregnant woman by making her lie alternately on the right and left sides.

Finally, that which powerfully corroborates the opinion of this physician is, that the *bruit de soufflet placentaire* is sometimes heard in the cases where any tumour whatsoever compresses the large vessels of the abdomen, insomuch that a case of this kind was mistaken for pregnancy *.

These facts are sufficient to combat the opinion of Laënnec, and if ordinarily the *bruit de soufflet* be heard on one side only, this may depend, as M. Bouillaud has remarked, on the circumstance that the hypogastric and external iliac arteries are not equally compressed on both sides.

M. Paul Dubois thinks that this noise takes place in the vascular system of the tissue of the uterus.

It is towards the lateral parts of the abdomen that the *bruit de souffle placentaire* is best heard.

The double pulsation heard on applying the ear to the abdomen of women arrived at the middle of the term of gestation, is evidently owing to the pulsations of the heart of the fœtus. A tolerably exact idea of this noise will be obtained by listening to the tic-tac of a watch placed under a pillow upon which the head rests. The intensity of the noise is proportional to the advanced existence of the fœtus.

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* See the Lancette Française, numéro du 8 Mai, 1834.—*Note of Author.*

M. Bouillaud has observed that the number of pulsations is in the inverse ratio of the age; he has observed this number amount to 170.

M. Paul Dubois says that the number of the pulsations of the fœtus is generally between 150 and 160, independently of the age; but, as M. Dubois himself allows, he has only made these observations upon women advanced in pregnancy at least six months. It is probable, therefore, that the difference of the epochs of pregnancy at which these distinguished practitioners have observed the fœtus is the only cause of their difference of opinion.

You may sometimes hear the double noise of the fœtus over several points of the abdominal parietes. Sometimes, as M. Paul Dubois says, the pulsations of the heart, when they are very distinct, cause a *bruit de souffle* to be heard analogous to that heard in certain affections of the heart in adults. This celebrated accoucheur asserts that it is owing to the mingling of the two columns of blood of the pulmonary artery and the aorta.

This explanation, though merely hypothetical, is extremely ingenious.

After what has been said of the bruit de soufflet placentaire, it is evident that we should not attach a great importance to it as a sign of pregnancy.

It is altogether different with respect to the double noise of the pulsations of the heart of the fœtus. Whenever this noise is heard, we may be certain that the pregnancy is real, and not only so, but also that the infant is living, a circumstance of high importance in judging of pregnancy.

M. Bouillaud was called in to a female scarcely arrived at the seventh month of her pregnancy, and attacked with a severe inflammation of the lungs. Her infant was living.

By means of auscultation the noises of the heart of the fœtus were heard, which was beating 170 times in the minute. But the signs of premature labour increased, and quickly M. Bouillaud withdrew a fœtus which gave no signs of life. "The patient having ceased," says this celebrated physician, "to feel her infant move for many days, it might have been supposed that it was really dead before delivery, and thus neglected all proper means to call it to life. But having heard the pulsations of the heart some minutes only before delivery, I was anxious to rub it, plunge it in a bath slightly exciting, and inflate air into its mouth, and after having prolonged for a sufficient length of time these manœuvres, I finally restored the infant to life; it struggled, cried, and lived to the end of the day."

We will cite another case, which shows in another manner the great utility of auscultation in pregnancy.

Some months ago I was summoned to a young female, who declared herself pregnant for the first time, and made her pregnancy date seven months back. She told me that she had experienced all the signs of pregnancy; cessation of menstruation, gradual swelling of the abdomen and breasts, and movements of the fœtus, but that for the last month all these phenomena ad disappeared. I found her in the pains of labour.

I attentively auscultated the abdomen, but I could not hear the noises of the heart of the fœtus; this circumstance confirmed the opinion which I had already conceived of the death of the fœtus, owing to what the mother had herself told me. The accouchement, which took place immediately, verified my presumption.

Under this point of view, auscultation will acquire a great importance in questions of medical jurisprudence.

It may also throw considerable light, as Laennec himself remarked, upon the diagnosis of multiplied pregnancy.

SECOND PART.

APPLICATION OF AUSCULTATION AND PERCUSSION TO THE DIAGNOSIS OF DISEASES.

CHAPTER I.

AFFECTIONS OF THE ABDOMEN.

SECTION I.

Affections of the Liver.

We have mentioned, in the chapter on percussion of the thorax, the procedure for examining the liver.

This organ presents, according to M. Piorry, two inches and a half or three inches in height towards the part nearest the sternum, four inches more outwardly, and four or five inches in the lateral region. Its transverse diameter is ten or twelve inches in length.

The knowledge of these limits, and of the means of determining them, renders easy the appreciation of the different morbid conditions of this organ, which are manifest by the augmentation of its volume.

Thus, when, in certain cases of acute hepatitis or congestion, whether active or passive, the liver augments considerably in volume, you are able to determine all the diamèters by means of mediate percussion, and thus follow day by day the diminution of volume, which sometimes arrives very rapidly after bleeding.

At other times the hypertrophy is only partial, and only occupies the left lobe of the liver, which in that case frequently extends as far as the spleen.

There are many practitioners who, finding in this case the epigastrium painful, would attribute this state to the existence of gastritis. In such cases, mediate percussion will show us the *matité* of the prolongation of the left lobe of the liver superficially, and more deeply the tympanitic sound of the stomach.

In other cases, the intestines push the liver upwards, so that the respiration becomes troubled. If the physician be not very familiar with percussion, he will frequently in such cases refer the dyspnœa to an affection of the lungs, or the pleuræ; whereas percussion will point out the total displacement of the liver, passing as much above its upper limit as it is removed below from its under one, and find the tympanitic sound of the intestines above the border of the false ribs, over an extent much greater than in a normal state.

At other times it is the superior border only of the liver which rises, without the other parts of this organ being displaced. This state can only be verified by percussion.

The presence of an effusion on the right side does not hinder the examination of the superior border of the liver posteriorly. In fact, by making the patient lie on the abdomen, the liquid will descend by its fluidity, and the liver present itself alone to the examiner. It would be only in cases of very considerable effusion, where the liquid could no longer be displaced, that percussion would be but of little service.

If the liver surpass the border of the false ribs, it is equally easy to determine its prolongation downwards, and to distinguish it from tumours.

Neither will the complication of ascites prevent the presence of the liver below the border of the false ribs from being discovered. The *matité* and *resistance* of this organ are always more marked than those of an effusion. If the patient be lying on the back, it will be very convenient to depress with considerable force the abdominal parietes, so as to bring them in contact with the liver. Or you may order the patient to lie alternately on the left and right sides. It is principally when the effusion is very considerable that you should proceed in this manner. In fact, the liver, being heavier, will apply itself better to the abdominal parietes, when the patient is lying on his right side, than in any other position.

It may happen in this case that an intestinal ansa is interposed between the liver and the abdominal parietes; then, before pronouncing upon the state of this organ, when such is suspected to be the case, the percussion should be repeated, taking care at the same time to depress the plessimètre with sufficient force. In this manner the intestinal ansa, reduced to a membrane, applied to the liver, becomes obliterated, and it is easy to determine whether the liver passes below the border of the false ribs.

As to the nature of the different tumours which have their seat in the liver, percussion will not give us very precise information on this subject. However, if the tumours be superficial, the elasticity and feeble resistance to the fingers will distinguish abscesses from scirrhous masses, which latter are characterised by considerable resistance.

Hydatid tumours may sometimes be recognised by means of a vibratory sensation felt by the fingers.

SECTION II.

Distension of the Gall Bladder.

In the normal condition the gall bladder scarcely passes beyond the inferior limit of the liver, so that it is impossible to recognise its presence by percussion. The case, however, is different when it is distended.

When the gall bladder is distended, you proceed in the following manner to examine it:—You percuss transversely the space situated immediately below the inferior edge of the liver, where, in the normal condition, you find, without intermission, the tympanitic sound of the intestines. But when the gall bladder is distended, you will perceive in the region of this organ a slight *matité,* without resistance to the fingers; and most frequently, according to M. Piorry, you will there find the *bruit humorique.* These signs succeed uninterruptedly the *matité* of the liver superiorly, and quickly give place to the *son tympanique* of the intestines in all the other directions. But these same signs might also be produced by the presence of liquids and gas in an intestinal ansa. If these characters persist in the same point when the patient lies on the side, the presumption that they are owing to the presence of the gall bladder will be changed into certainty; otherwise the liquids should be displaced by changing position.

SECTION III.

Swelling and Hypertrophy of the Spleen.

Swelling of the spleen is of more frequent occurrence than its real hypertrophy. It so frequently accompanies intermittent fevers, that of late this organ has been regarded as their point of departure.

Without prejudging this question, which is foreign to our subject, we cannot deny that the swelling of the spleen appears and disappears most frequently with the fever, and that whenever it remains after the cessation of the fits or attacks, their return is to be apprehended, and the treatment which has suspended them to be continued.

To determine, therefore, the volume of the spleen is very important, and it is principally by means of mediate percussion that this can be done with exactness.

If it be possible to detect certain cases of hypertrophy by the touch, where the spleen passes considerably below the border of the false ribs, it cannot, however, be applied to the cases of hypertrophy, which, though not frequent, are not, however, very rare where the spleen is prolonged upwards instead of extending downwards.

It is for mediate percussion to determine the nature of the evil, where this affection occasions dyspnœa, and causes an affection of the respiratory organs to be apprehended.

SECTION IV.

Dilatation of the Stomach.

We have already observed, in the chapter on percussion of the thorax, that the mobility of the stomach prevented our assigning to it precise limits. However, with a little practice, the ordinary state of this organ cannot be confounded with an abnormal distension of it.

In the latter case, if the stomach be filled with gas, it will yield a tympanitic sound over a more considerable extent than in a normal condition.

There have been some cases of excessive dilatation, where the stomach descended almost as far as the iliac regions. In other cases of dilatation, the stomach, instead of descending, pushes the diaphragm upwards, and occasions dyspnœa. More than once, percussion has discovered this condition of the stomach in affections presumed to belong to the respiratory organs.

SECTION V.

Stercoraceous Concretions.

The intestines give, in general, the *tympanitic* sound, though less clear than that of the stomach. This clearness of sound is owing to the presence of a greater or less quantity of gas. It disappears by the accumulation of stercoraceous matter in the large intestines, which occasions various derangements in the economy.

At one time these concretions or substances only produce a simple obstruction, which can only be detected by mediate percussion, and especially that with the plessimètre. By this means, *matité* will be found in the region corresponding to the accumulation of the fœces, and the fixed situation of this *matité* will easily enable the examiner to distinguish this condition from an effusion in the abdomen.

Another time, the intestine, filled at once with liquid and gaseous matters, will yield the *son hydropneumatique.* But since, according to M. Piorry, the same noise may be met with in the case of inconsiderable effusion, complicated with tympanitis, it will be of great importance to distinguish these two cases. You will obtain this object by changing the position of the patient.

The fœces may also be assembled in globular concretions, and thus cause projections outwards. More than once these concretions have been confounded with tumours of an altogether different nature, either with abcesses, the opening of which had been determined on, or with agglomerations of the intestines, in consequence of peritonitis. Another time, the fœces, without projecting exteriorly, compress the adjacent vessels and nerves, and occasion either sciatica, or swelling of the leg, or, finally, owing to the compression of the ureter, the symptoms of nephritis.

All these cases have already been observed. I have collected them in a mémoire presented to the Faculty of Medicine at Paris.

It is principally by means of the plessimètre that the hidden cause of such various symptoms has been able to be discovered.

When the fœces form projections outwards, percussion discovers by the sound and resistance of the tumour, as well as of the adjoining organs, which of these organs is the seat of it. If it be the intestine, the nature of the tumour will declare itself by the progress and other symptoms of the disease.

In the cases in which the stercoraceous matter depresses the adjoining organs without being evident externally, the plessimètre, by depressing the abdominal parietes, discovers the presence of the fœces by their *matité* and their resistance, and indicates, in a certain manner, the efficacious treatment of a disease which has for a long time eluded all other remedies.

I lately saw at the Hôpital de la Charité, a woman thirty-eight years of age, attacked with peritonitis, brought on by stercoraceous concretion. This patient, habitually in good health, presented on her arrival a jaundiced complexion, and complained of constipation for some days back. The abdomen was painful on the slightest touch. This sign, united with vomiting, a small pulse, and expressions of suffering in the countenance, left no doubt as to the existence of peritonitis. But what was the occasion of it? Was it the cold to which the patient was frequently exposed in her employment as washing-woman? We were led to this conclusion, when we perceived a tumour; on percussing which, we found its seat to be in the transverse colon. This tumour had no adherences; was hard and knotted; the patient assured us that she herself perceived it for the first time.

This circumstance, joined to the deficiency of stools for some days, suggested the idea of a stercoraceous concretion, which, by distending the coats of the intestines, might have given rise to the peritonitis. But it became urgent to direct an immediate treatment against this latter affection. With this view, local bleeding was twice prescribed.

The pain disappeared as well as the other symptoms of the peritonitis; whereas the tumour remained.

This result corroborated our first presumptions. Accordingly, by the administration of purgatives, copious evacuation was produced, and the tumour disappeared.

SECTION VI.

Distension of the Bladder.

In affections of the brain, in severe fevers, in cystitis, &c., it is not rare for the bladder to be distended with urine without the patient's being aware of it. This circumstance frequently aggravates the malady. This complication becomes especially dangerous when the physician's attention is not speedily drawn to it.

To prevent this complication, those, most cautious, address to their patients the necessary questions for ascertaining the state of the bladder, and examine that organ by means of the touch, and passing the catheter. But the first method is not always sufficient for ascertaining the distension of the bladder; and the second, although it consists in an easy operation, is frequently painful, and by frequent repetition may produce inflammation.

Mediate percussion, on the contrary, conducts to an exact diagnosis without offering the inconveniences of passing the catheter.

To examine properly the bladder by means of the plessimètre, the patient should lie on his back, and the instrument be applied over the navel, and at the same time somewhat forcibly depressed in order to obliterate the intestinal ansæ interposed between the bladder and parietes of the abdomen. It is rare for the bladder to extend upwards as far as this point, where consequently you will only find the *son tympanique* of the small intestines, which sound, as you descend along the linea alba, quickly gives place to *matité*, accompanied with a slight resistance if the bladder be distended. These two characters continue increasing in proportion as you approach the pubis. This examination should be repeated on both sides of the linea alba. If the *matité* be due to the presence of the bladder, the points of transition from the clear sound of the small intestines to the dull sound will not form a straight line, but a bent one corresponding to the superior circumference of the bladder. You will have more certainty on this subject, if, on making the patient lie alternately on both sides, and exploring successively the abdomen, the *matité* does not change.

SECTION VII.

Examination of Effusions in the Abdomen.

In order to recognise effusions in the abdomen, *fluctuation* is the method of investigation generally employed. But this method often gives obscure results.

Mediate percussion, and principally that with the *plessimètre,* will permit us not only to verify the presence of liquid in the abdominal cavity, but also to determine its level.

You begin this examination with the umbilical region. If there be an effusion in the cavity of the peritoneum, the intestines being filled with gas, float above the liquid by reason of the greater specific gravity of the liquid, and assemble at the highest part of the abdomen; the umbilical region will therefore yield the *son tympanique* of the intestines.

This tympanitic sound will continue more or less low around the umbilicus, according to the height of the liquid. To determine precisely its level, you must percuss gently the superior part of the abdomen.

A gentle percussion, when the plessimètre encounters the liquid, yields the *son mat,* or sometimes *humorique,* on account of the shock of the liquid against the intestines. If, on the contrary, the percussion were forcible, the vibrations, by being communicated as far as the intestines, would produce a clear sound notwithstanding the presence of a small quantity of liquid.

Below this level the liquid becomes deeper and deeper, and the *matité* increases in proportion.

After having marked with nitrate of silver the transition from the *son clair* to the *son mat* or *humorique,* all round the umbilicus, you will have an exact idea of the superior circumference, or of the level of the liquid.

This examination repeated every day will verify mathematically the progress of the malady.

In order to be still better assured that the *matité* is owing to liquid contained in the cavity of the peritoneum, it is necessary to alter the position of the patient. In this case the *matité* will change place with the liquid, at least if the effusion be not very considerable.

If, on the contrary, the effusion be inconsiderable, it is more difficult to recognise; you may, however, succeed by the two following methods:—I have already mentioned that the cœcum always gives the *son tympanique* in the normal condition. When, therefore, you presume that there is only a slight effusion, the patient should be made to lie on the ilio-cœcal region, and if, in this position, the *son tympanique* no longer exist in this region, the presumption will be changed into certainty*; or the patient may be made to lie on the abdomen†; in this case, the liquid descending upon the umbilical paries will occasion a *matité* which does not exist in the normal condition.

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* This ingenious method was, I believe, suggested by M. Piorry. —*Note of Translator.*

† Or rather, speaking more accurately, "the patient should be made to recline on his knees and elbows."—*Note of Translator.*

CHAPTER II.

AFFECTIONS OF ORGANS CONTAINED IN THE THORACIC CAVITY.

FIRST ARTICLE.

AFFECTIONS OF ORGANS OF THE RESPIRATION.

SECTION I.

Bronchitis.

THE name of bronchitis or catarrh is given to the inflammation of the mucous membrane which lines the internal surface of the bronchi throughout their whole extent.

At the commencement this affection gives rise to no *râle*.

Have not, however, the cessation of secretion and the dryness, which are peculiar to the first period of bronchitis, some influence upon the respiratory noise?

No observer, to the best of our knowledge, has yet fixed his attention upon this subject. An attentive observation has shown me that, at the commencement of bronchitis, the respiration is always more rough than in the normal condition. This simple roughness of the respiratory murmur results from the friction of the air against the dry parietes of the bronchi. The same phenomenon is observed at the commencement of eruptive fevers, and of all other affections which present decided fever.

Presently the period of secretion comes on, and the patients begin to expectorate a white viscous substance in small quantity.

The mucous membrane of the bronchi is as yet too sensitive to allow these substances to remain, so that they are expectorated in proportion as they are secreted; and for the most part do not produce any of the noises arising from the displacing of the liquid.

But I do not think that these substances are altogether foreign to the noises sometimes observed during the first few days of acute bronchitis. I think that it would be difficult always to explain the *râle sibilant*, which is sometimes observed at this period, by the simple *engorgement* of the mucous membrane; and that most generally this *râle* is occasioned by a thin lamina of viscid mucus lining the internal surface of the bronchi, the tubes of which are already more or less diminished by the engorgement. The sudden appearance and disappearance of this noise after the expectoration of a small quantity of viscid mucus is thus easily explained. At the same time that the *râle sibilant* is heard at certain points of the chest, another noise is also frequently heard, generally known since Laënnec's time under the name of *râle sonore grave*.

This latter noise is perhaps even more variable than the *râle sibilant*. I have frequently known it disappear in the very points where a moment before I had verified its existence.

If the *râle sonore grave* be only observed at intervals, and disappears after expectoration, it is highly probable that it is owing to the vibrations of a certain proportion of viscid mucus, which either by itself alone diminishes the calibre of the tubes of the bronchi, or is attached to the edges of a slight stricture of the bronchi, and that the *engorgement* of the mucous membrane is not as yet very considerable.

It is evident, from what we have just said, that it is often difficult at the commencement to declare the presence of bronchitis by the simple signs of auscultation.

Neither does percussion offer us greater light at this period; the air enters in general in sufficient quantity into the lungs for them to present on percussion the clear normal sound.

All that we have yet said is applicable to a slight attack of acute bronchitis. But if this affection be very intense, the *râles sibilant* and *sonore* will be heard over a considerable extent of the chest and more permanently. The air can no longer enter in sufficient quantity into the pulmonary vesicles, the respiratory murmur is scarcely heard, and percussion yields a sound more or less dull.

When the substances secreted by the mucous membrane of the bronchi become more copious, and the expectoration is not proportionate to the secretion, the displacing of the mucus during the passage of the air occasions a particular noise, which we have already noticed under the name of *râle muqueux*, and which is heard equally well during inspiration and expiration; or it occasions the *râle sous-crépitant,* if the displacement of the liquid takes place in bronchi of small diameter;

this latter râle resembles more nearly the *râle crépitant* of pneumonia, inasmuch as it is dry, and only heard, for the most part, during inspiration.

Frequently enough the union of the abnormal noise of the respiration in bronchitis imitates tolerably well the cooing of doves, or different birds, or the sound of a carpenter's plane.

If acute bronchitis pass to the chronic state, the intensity of the inflammation diminishes, but still the signs of auscultation which we have observed during the first period most frequently persist, and besides new ones are observed.

In fact, in chronic bronchitis it not unfrequently happens that one of the tubes of the bronchi becomes obliterated. In this case, percussion will give in general the clear sound, but on auscultating the region which corresponds to the part of the lungs which receives the ramifications of the obstructed bronchus, the respiratory murmur will not be heard.

The same absence of the respiratory murmur is observed in emphysema; but, although the confusion of these two morbid conditions would not be attended with dangerous consequences, you may frequently distinguish them by the duration of the signs drawn from auscultation; it is thus that once I happened to mistake the obstruction of a bronchus for emphysema, but I quickly perceived my error, when, at the end of a few days, the respiration was audible in the parts where it before did not exist. If the case in question had been one of emphysema, the respiration would not have been audible in so short a time.

At another time a bronchus is completely obstructed by viscid matter. If this obstacle takes place in one of the first divisions of the bronchi, it produces considerable dyspnœa, the patient changes from a recumbent to an upright position, and makes vain efforts to respire. The chest, if percussed, gives a clear sound, but the respiratory murmur is obliterated over the whole portion of the lungs which receives the ramifications of the obstructed bronchus.

This instantaneous change in a region which before yielded the abnormal signs of auscultation, will enable us to distinguish this condition from the preceding ones. If unfortunately it were not quickly recognised and an appropriate remedy applied to it, the patient would quickly perish. M. Andral cites a similar case in the first volume of his excellent work (*Clinique Médicale*).

Dilatation of the bronchi is of frequent occurrence after chronic catarrh.

Dilatation may take place either in the entire passage of the bronchi or only partially.

In the former case, the air passing by the tubes of the bronchi of considerable calibre, produces a *souffle* more or less diffuse. And, if besides, there be any liquids in the passages, the air by displacing them will occasion a *râle muqueux à bulles très-grosses* ("mucous râle where the bubbles are very large"), resembling very nearly the *râle caverneux* or *gargouillement*.

When the patient, thus affected, talks, the voice resounds forcibly throughout the whole extent of the dilated bronchi, so that you hear the *bronchophonie*, and sometimes even the *pectoriloquie*.

Percussion executed along the course of the dilated bronchi will give a sound clearer than in the normal condition, and sometimes even the *bruit de pot fêlé**.

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* I have at present under my observation a patient who offers the

But if the dilatation be not considerable, at the same time that it attacks several bronchi at once, percussion will the most frequently offer a dull sound, which is produced by the occlusion of the cavities of the vesicles compressed by the parietes of the dilated bronchi.

After what we have said, it will be seen that there is considerable analogy between the signs of auscultation which accompany dilatation of the bronchi and those of a cavern. In fact, it has been seen that a dilatation of the bronchi may occasion a *souffle* called *caverneux*, *gargouillement*, and *pectoriloquie*, which are the characteristic signs of a cavern of the lungs.

However, if these phenomena be repeated over several points at once, which is the case when dilatation of the bronchi extends over a considerable part of the chest; if, during the progress of the malady, none of the rational signs of phthisis tuberculosa be observed, such as excessive perspiration and diarrhœa, the diagnosis will cease to be uncertain. But it will become much more difficult, if the dilatation be circumscribed and confined to a single bronchus. In fact, in this case, the dilated bronchus will be in conditions very nearly analogous to those of a cavern. In both cases *souffle caverneux* and *pectoriloquie* will be circumscribed. In both cases percussion may offer the *bruit de pot fêlé*. It is only then the presence or absence of rational signs which can throw light upon the diagnosis. However, let us not dissemble the difficulty: more than once have partial dilatations of the bronchi, accompanied with copious and fetid expectoration, been mistaken for caverns.

bruit de pot fêlé over several points of the chest. The circumstance of the multiplicity of this noise made me at first discard the idea of caverns, and auscultation confirmed my opinion.—*Note of Author.*

If a catarrh last for a long time, the parietes of the bronchi lose their elasticity. Expiration, in this case, only takes place incompletely; which facilitates the dilatation of the extreme ramifications of the bronchi, already favoured by the fits of coughing.

The dilatation of the vesicles is nearly stationary, and in autopsies they are frequently perceptible to the naked eye. This state of the lungs has been known since Laënnec's time under the name of *emphysème pulmonaire.*

The air not being able to dilate further the vesicles, and the latter not being able to retract during expiration, you will find no *bruit respiratoire.* Percussion will offer a clearer sound than in the normal condition, since the quantity of air contained in the lungs is greater.

The continuance of this state makes the lungs acquire a considerable volume; and the chest sometimes becomes protuberant on the side corresponding to the emphysema.

If, in the course of a chronic bronchitis, which is the point of departure of emphysema, there supervene several attacks of acute bronchitis, the fits of coughing augment in frequency, and it frequently happens that, in consequence of the efforts occasioned thereby, the pulmonary vesicles, already distended beyond measure, break. The air then escapes by a new passage in the interlobular cellular tissue and raises the pleura. The air as it thus passes occasions a particular noise, known since Laënnec's time under the name of *craquement,* or *râle crépitant sec à grosses bulles.*

And, if the air thus extravasated (*extravasé*) raise the pleura and form kinds of phlyctænæ, these, rubbed corresponding to the inflamed lungs, a sound less clear than in the normal condition. However, the *matité* will not be very marked on account of a greater or less quantity of air which still penetrates into the cavities of the vesicles.

If the inflammation augment in intensity, the pneumonia quickly passes to the second degree. The sero-sanguineous matter is secreted in greater quantity, its viscidity increases, and then a moment speedily arrives when it completely obstructs the cavities of the vesicles.

The lungs have then a greater volume, they do not collapse after the removal of the anterior part of the thorax, their tissue appears to be more consistent, and for this reason this state of the lungs has been called hepatisation.

But this augmentation of consistence is only a simple illusion. The parenchyma of the lungs is more friable, like all other inflamed tissues, and is in a real state of *ramollissement*, as M. Andral has observed *.

If the vesicles be uniformly distended by the sero-sanguineous matter, the sections of the inflamed lobes will present equal surfaces; but if the inflammation does not exist throughout with the same intensity, if only a small number of the cavities of the vesicles be obstructed, and the others filled with a small quantity of liquid or even still permeable by the air, these substances will escape on incision. The parietes of the vesicles will collapse, and the distended vesicles will present red, protuberant granulations above the level of the incisions.

When the lungs are in this state, the air no longer tutes the first phenomenon of auscultation in pneumonia. It is distinguished from the *râle muqueux,* because it is never heard excepting during inspiration, and also by a character of dryness in the sound. I think that we may distinguish two kinds of *râle crépitant.*

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* Clinique Médicale, tom. i. Andral.

It is never the *râle crépitant* alone that is heard over the whole extent of a lung at the first stage of inflammation. The secretion scarcely ever commences at once in all the vesicles. Some already contain sanguineous serosity, whilst the others are still completely permeable by the air. Hence it follows that the *râle crépitant* ought, at the commencement, to be mingled with the respiratory murmur.

If the malady advances, the secretion arrives in the vesicles where before it had not taken place, and the respiratory murmur is succeeded by the râle crépitant over a more considerable extent.

If, on the contrary, the malady diminish in intensity and the serosity be absorbed, the *râle crépitant* diminishes in the extent over which it was before heard, afterwards entirely disappears, and is replaced by the respiratory murmur.

The inflammation is only as yet at its first degree. The parenchyma of the lungs is soaked (*abreuvé*) with liquids, with which the vesicles are only partially filled, and which are susceptible of being displaced. On incision, these liquids issue forth together with air, and produce a crepitation analogous to that heard in lifetime during respiration. If you compress the lung thus inflamed with the stethoscope, you hear the same noise.

The percussion of the chest will offer, in the points

The signs of auscultation in pneumonia at the third stage do not differ from those at the second stage.

The formation of abscesses in the lungs is not so frequent as was formerly supposed: now that the researches of morbid anatomists are more scrupulous, we can only reckon some few incontestable examples.

If, however, an abscess be formed in the lungs, its presence will be detected by the *gargouillement, souffle,* and other signs of a cavern. The rapid appearance of these signs in the course of an acute pneumonia, will enable us to distinguish between an abscess and a real cavern, the result of the previous existence of tubercles.

When the lungs are gangrenous, the fetidness and other characters of the expectoration will enable us to distinguish this case from a tubercular cavern or an abscess.

Instead of terminating in any of the modes we have indicated, acute pneumonia may pass to a state of chronic induration; which state may indeed come on primitively. In this case, the signs of auscultation will not differ from those of acute pneumonia except by their progress and their duration.

When instead of following a progressive march, pneumonia at the second stage proceeds towards resolution, the *souffle, bronchophonie,* and *matité* disappear gradually, and are succeeded by other signs.

The lungs never pass immediately from a state of hepatisation to a normal condition. This transition takes place gradually by the absorption of a part of the viscous matter which obstructs the cavities of the vesicles. By means of this subtraction, the other part becomes susceptible of being displaced by the air, so that you hear afresh the *râle crépitant* at the part where it was replaced by the *souffle bronchique.*

This re-appearance of the *râle crépitant* is known under the name of *râle crépitant de retour* ("râle crépitant on its return").

All the sero-sanguineous matter is quickly absorbed, there is nothing remaining to produce the *râle crépitant,* and the normal respiration arrives.

These changes do not come on simultaneously in all parts. But whilst, in certain points, the *souffle* is succeeded by the *râle crépitant,* or the *râle crépitant* by the normal respiration, in other points the *râle crépitant* scarcely begins to appear.

According to all these facts, it is evident that, by means of auscultation and mediate percussion, you can exactly follow the progress of pneumonia, and that the ear can discover this affection in many cases where the dyspnœa, expectoration, and other signs, do not at all lead us to suspect it.

However, we should be wrong in asserting that auscultation is an infallible means of diagnosis.

When the inflammation only attacks certain points of the centre of the lungs, the abnormal noises, if there exist any, will be masked by the normal noise of the surrounding parts. It will be the same in those cases of pneumonia where the numerous small lobes inflamed are surrounded by others in a healthy state.

How great is the difficulty in recognising, by means of auscultation, a partial inflammation of the base of the lungs!

Some authors, and M. Andral in particular, declare that they have sometimes observed on the side partially affected, the puerile respiration. M. Andral cites this circumstance as being capable of throwing some light on the diagnosis.

Let us, however, confess that this case is a very difficult one. How are we to recognise which of the lungs is affected, when the respiration is audible and unaccompanied by *râles* on both sides; and should we not most frequently be induced to consider that lung as affected in which the respiration was the feeblest?

But in the cases where the existence of pneumonia is beyond doubt, does it always follow the same course? Does the *râle crépitant* constantly precede the appearance of the *souffle bronchique*, and is the latter constantly followed by the former before the return of the normal respiration? When at the commencement of a malady you find the *souffle bronchique*, and together with it all the other signs of pneumonia, must we regard the affection as such, although the *râle crépitant* has not preceded?

All these questions are of great importance and merit our consideration.

We mentioned above, in speaking of the morbid anatomy in pneumonia, that the inflammation of the pulmonary vesicles has almost always for immediate effect the secretion of a sero-sanguineous liquid capable of occasioning the *râle crépitant*.

But there are other cases not altogether identical.

We will cite two cases, where the malady has commenced with the *souffle bronchique*, which remained during the whole of its course, until the return of the normal respiration.

First Observation.

N * * *, thirty-two years of age, mason, entered, 24th December, 1834, the Hôpital de la Charité, No. 18, Salle Saint-Jean-de-Dieu. Generally in good health, ill during two days. The night of the 22nd got up from his bed, and felt a sensation of cold. The next day he began to feel a pain in the side and to cough. Shivering fits came on about ten o'clock in the evening, accompanied with expectoration of blood.

State on the 25th. Considerable dyspnœa, countenance flushed, pulse 100. Resonance of the voice, and the respiration normal on the anterior part of the chest. Posteriorly and to the right, complete *matité* at the summit of the lung; *souffle bronchique* in the same region, and *bronchophonie*. Lower down, no abnormal signs; to the left, the respiration and resonance are good. The most minute attention could not enable us to discover the *râle crépitant*. Sensation of heat in the chest, characteristic expectoration of pneumonia. (Infusion of violet and marsh-mallow. Bleeding of sixteen ounces, to be repeated in the evening; cupping with scarifications over the part affected, so as to take away twelve ounces of blood. Flannel waistcoat.)

26th. The blood is cupped. No *souffle bronchique*, no *râle crépitant*, and the normal respiratory murmur is audible at those points where the presence of the *souffle* was verified. Twenty-two inspirations; pulse 66. Expectoration of a better aspect. (Poultice; emollient clysters. Thridax, 8 gr.)

27th. Pulse 88. The rest as above.

28th. Expectoration viscous, mucous, somewhat yellowish. The pain in the side returned. The respiration more rough than in the normal condition; no *souffle*, no abnormal resonance of the voice. (Infusion of violet and marsh-mallow. Emollient clysters. Poultice. Diet.)

Since this period the patient is convalescent. No abnormal noise is heard. He is allowed food, and goes out of the hospital on the 8th, in a most satisfactory state.

The malady which is the subject of this observation presents all the characters of pneumonia at the second stage: *matité* with resistance to the fingers; *souffle bronchique, bronchophonie,* and characteristic expectoration, but, notwithstanding, the *souffle* was neither preceded nor followed by the *râle crépitant.*

It is true that we have not traced the malady from its commencement; but if the râle had existed at the commencement, it is extraordinary that we should not have met with at least some traces of it the third day. The ulterior progress of the malady corroborates our opinion. We saw, in fact, the *souffle bronchique* pass immediately to the normal respiratory murmur.

What is the reason of this anomaly? It appears to me to depend on a peculiar disposition of the parts affected. Ordinarily, the inflamed vesicles secrete abundantly a sero-sanguineous liquid, which, being displaced by the air, occasions the *râle crépitant.* Presently this liquid becomes more solid, and completely obstructs the cavity of the vesicles; so that the air is arrested in the bronchi, and produces the *souffle bronchique.* Is it then by this more solid substance that the *souffle* observed in the case in question was produced? I do not think so. This substance was secreted in too small a quantity to be able to obstruct the vesicles. The expectoration was inconsiderable in quantity. It appears to me probable that the principal pathological element in this affection was a considerable congestion of the respiratory organs, accompanied also with considerable thickening of their parietes, which thus touched one another in the vesicles, and effaced their cavities.

Second Observation.

F. A., joiner, fifty-one years of age, entered, 18th of February, 1834, at the Hôpital de la Charité, No. 12, Salle Saint-Jean-de-Dieu.

General health good; on 7th of February, after having drunk the evening before a quantity of very cold cider, he began to feel heat in the chest, feebleness, thirst, and cough. The expectoration was of the colour of saffron. In this condition he kept his bed till the 18th.

State on the 19th. Prostration, eyes heavy, countenance resembling that of persons affected with cholera. Tongue dry and clammy; lips dry, as also the teeth. Anorexia, thirst, respiration slow, scarcely rendering perceptible the movements of the thorax. No dyspnœa, no expectoration.

Percussion yields a clear sound over all the extent of the chest to the left; to the right, only in the inferior part. Upwards on the same side the sound is dull, both anteriorly and posteriorly. The respiratory murmur is heard very well to the left and right, every where that the clear sound is found. Towards the summit of the right side you hear the *souffle bronchique* and *bronchophonie*.

Pulse 66; sixteen inspirations. The skin neither very hot nor very dry. Nothing on the side of the digestive organs. (Infusion of marsh-mallow; oxide of antimony; laxative clyster; diet.)

20th. Same state, no expectoration (ut supra).

21st. Tongue more moist. Sound less dull at the summit of the right lung. The *bronchophonie* remains. Three alvine evacuations (ut supra, and in addition chicken broth).

22nd. The sound yielded by percussion is scarcely different on either side; the respiratory murmur returns at the summit of the right lung posteriorly. (Three cups of chicken broth.)

23rd. The *souffle* is very inconsiderable at the summit of the right lung. (Same prescription.)

24th. The pulse preserves its force and suppleness, beats 60; appetite good, the respiration more audible at the summit of the right lung. (No oxide of antimony, the rest as above.)

25th. Mucous expectoration, somewhat yellowish; the voice resounds a little more at the summit of the right lung than on the opposite side. (Small allowance of animal food.)

The following days the respiration approaches nearer and nearer to that in a normal condition. The patient is allowed a larger proportion of food. No trace of the *râle crépitant* or *muqueux*. Leaves the hospital the 19th, in a very favourable state.

It is true that, in this observation, we have only pursued the malady from the eleventh day of its attack, so that the pneumonia had had sufficient time, according to its ordinary march, to pass to the second period before we began to make our observations.

But judging according to the termination of the malady, which, after having presented in its course the *souffle* and *bronchophonie*, passes immediately to the normal condition, without presenting any intermediate noises before the return of the respiratory murmur, I think there is sufficient reason to believe that this affection, like the preceding one, consisted principally in a considerable congestion of the parietes of the vesicles, and in the consecutive obliteration of their cavities.

This pathological condition satisfactorily explains the complete absence of the *râle crépitant de retour*, and also furnishes us with a strong presumption of the absence of the primitive *râle crépitant.*

These two cases should be sufficient to show that the manifestation of the *râle crépitant* is not absolutely necessary in the course of pneumonia, and that the *souffle bronchique* may appear in this affection without being preceded by the *râle crépitant.*

At another time the pneumonia is detected by the examiner by means of pathognomonic expectoration, by considerable dyspnœa, and a high state of fever, and, notwithstanding, the ear can distinguish neither *souffle* nor *râle crépitant;* the respiratory murmur is scarcely heard, and a *matité,* more or less pronounced, replaces the clear sound of a normal condition. We have here another variety of pneumonia, where not merely the *râle crépitant,* but also the *souffle bronchique* are completely wanting.

We will merely mention, in passing, the cases of peripneumonia notha, so well described by M. Piorry, where you frequently observe no other sign of pneumonia than *matité.*

These anomalies, far from putting in the back ground the immortal discovery of Laënnec, have only been able to be fully appreciated and analysed by its means. And so far is it from being uncertain itself, that it has convicted the other signs of imperfection and fallibility, when they did' not take account of differences which we, by Laënnec's method, have not only been able to observe, but also to explain.

SECTION III.

Pleurisy.

This is the name given to the inflammation of the pleura. This inflammation sometimes attacks both the pulmonary and costal pleura to a considerable extent, which constitutes general pleurisy. Sometimes it is confined to a small portion of the pleura, which constitutes the partial pleurisy of some authors.

Pleurisy, like the inflammation of every serous membrane, offers to our consideration alterations of the pleura itself, and also alterations of the liquids secreted by this membrane.

When there is only a simple congestion of the membrane, or of the subjacent tissue, percussion will not be able to detect any abnormal character, unless, indeed, this state last during several days. In this case of persistance, as Corvisart has already observed (an observation which I have myself recently verified), percussion may offer a *matité*, more or less considerable, according to the density of the inflamed tissues.

If to the inflammation there be joined, as is most frequently the case, a severe pain, the patients dilate the affected side less, consequently the air enters in less quantity into the corresponding lung, and the respiratory murmur is less audible on that side than on the side not affected.

When the inflamed pleura secretes coagulable matter, this matter quickly forms into a false membrane, which sometimes covers one of the pleuræ to a more or less considerable extent, sometimes unites the costal to the pulmonary pleura.

It is now demonstrated, by the experiments of M. Reynaud, that during each inspiration the pulmonary approaches the costal pleura. If, therefore, the pleuræ be covered with false membranes, these latter, rubbing against each other during each movement of the respiration, will produce an abnormal noise, known under the generic name of *frottement* ("friction").

This noise may have various shades of difference. Sometimes it is so slight that it scarcely deserves the name of *frôlement* ("grazing slight touch").

Sometimes I have observed, that it strongly resembled the *bruit de cuir neuf;* and at the autopsy have found in the part corresponding to its manifestation, a false membrane of a fibrous nature, uniting the two pluræ.

At another time it bears a strong analogy to the *râle sonore,* or the *râle crépitant,* and in these two latter cases the very superficial origin of the noise, as well as the possibility of hearing the normal respiration in the same point, were the motives for explaining its presence by the existence of false membranes, which opinion was moreover corroborated by other signs of pleurisy.

When these different noises are very marked, the hand, if applied to the parietes of the chest, will feel vibrations during the movements of respiration.

If the liquid secreted by the inflamed pleura does not collect into false membranes, effusion takes place in the cavity of the pleura, which by virtue of its fluidity assembles at the lowest part of the chest; so that, if the patient be in an upright posture, it descends behind the pillars of the diaphragm, near the vertebral column. Its presence is detected by means of the dull sound offered by percussion in this part. But it should be remarked, that this dulness of sound is never so pronounced as that of pneumonia at the second stage.

A small quantity of liquid in this region may rise to a considerable height, on account of the very narrow dimensions of the inferior part of the cavity of the pleura. This circumstance should be taken into consideration in estimating the quantity of liquid.

Sometimes the liquid will occupy only two or three inches in extent, and the diagnosis will then require considerable attention.

You will distinguish the *matité* of the liquid from that of the liver, both by the greater resistance of the latter, and by its position at a greater distance from the vertebral column.

The difference between the *matité* of the spleen and that of the liquid will not be so remarkable. But it is sufficient to presume the presence of liquid, to find dulness of sound near the vertebral column, between the median line and the spleen, a region which in the normal condition yields a clear sound, owing to the presence of a thin lamina of lung.

When the liquid is not in any very considerable quantity, the parietes of the vesicles being compressed, they approach one another, and their cavities become obliterated. The air no longer enters into the vesicles, and you cease to hear the respiratory murmur, but in its place the *souffle bronchique* becomes audible.

However, if the effusion be so considerable that it nearly fills the cavity of the pleura, you will hear neither the respiratory murmur nor the *souffle bronchique*, except along the vertebral column where the lungs are pushed back. In proportion as the effusion diminishes, the *souffle bronchique* appears again, as well as *égophonie*; but when the effusion is absorbed these two signs disappear, as well as the dulness of sound, and are succeeded by normal signs.

When the effusion occupies only one side of the chest, the opposite side presents puerile respiration.

If a patient affected with effusion in the cavity of the pleura be made to talk, and the hand be at the same time applied to the parietes corresponding to the liquid, it will only feel very slight vibrations, or even none at all; whereas, these vibrations are very perceptible in a state of health.

This fact was observed by M. Reynaud.

When you apply the ear over the part of the chest corresponding to the effusion, and make the patient talk, his voice resembles that of a goat, whence Laënnec gave to this peculiar broken resonance of the voice the name of *égophonie*.

We have already given an explanation of the mechanism of this noise. We have said that *égophonie* depends upon the vibration produced by the voice in a membrane, resulting from the compression and juxtaposition of the most superficial vesicles. This membrane only vibrates when it is thin, and, consequently, *égophonie* only exists when the liquid is in moderate quantity.

The possibility of hearing the *râle crépitant* in individuals who present *égophonie* at the same time that they are attacked with pneumonia at its first stage, also proves that the compression extends only to the most superficial vesicles.

Egophonie is not always so marked as to make it easy to distinguish it from *bronchophonie*. On the other hand, some persons when in good health have the voice so broken, that it is very easy to make a mistake. Wherefore we should conclude that, in a great many cases, *égophonie* should only be regarded as an auxiliary sign.

Neither is the default of the vibrations of the chest, during the act of speaking, in the parts corresponding to the effusion, very perceptible, when the effusion is inconsiderable in quantity.

The *souffle bronchique* and the *matité*, characteristics of an ordinary effusion, are likewise observed in pneumonia at the second or third stage.

But, notwithstanding this coincidence, these two latter signs are not equivocal. In fact, if you make a patient, in whom you have observed *matité* and the *souffle* posteriorly and in an upright position, lie on the abdomen, the liquid will fall upon the anterior part of the chest, which is now become the lowest. Thus, the *matité* and *souffle* will disappear posteriorly, and be replaced by the signs of a healthy state, or by some râles, if the bronchi or parenchyma of the lungs be affected at the same time that there is effusion in the cavity of the pleura.

If you make the patient, maintaining this posture, approach the edge of the bed, so that you may be enabled to percuss the anterior part of the thorax, which is now become the lowest, this part, which before yielded a clear pulmonary sound, will in this case yield a dull sound arising from the presence of the liquid.

These two examinations of the anterior and posterior part of the chest, repeated alternately at different times, will leave little doubt as to the nature of the affection.

When the patient is lying on the abdomen, the examiner should be careful not to mistake the dulness of sound of the heart, which, in this position, is applied over a greater extent to the parietes of the chest, for that of the displaced liquid. This remark is due to M. Piorry.

However, the liquid will not be displaced except in the cases of moderate effusion. If one side of the chest be completely filled with liquid, the liquid will not change place, whatever be the position of the patient. But in that case the progress of the malady, united with the absence of the respiratory murmur and of the vibrations of the voice, as well as in connexion with certain rational signs, will throw light upon the diagnosis, and enable us to distinguish an effusion in the cavity of the pleura from a chronic *engorgement* of the lungs, with which it might be confounded.

Other circumstances may still further augment the difficulty of diagnosis of an effusion in the cavity of the pleura.

If false membranes retain the liquid on all sides, it will not be displaced by the patient changing his position. In this case the *souffle* and *matité*, common characteristics of effusion in the cavity of the pleura and hepatisation of the lungs, losing the distinction that existed between the two cases, will not clear our doubts; or, in other words, the immobility of these signs in both cases, would lead us to suppose that we had to do with a case of hepatisation.

It happens sometimes that the liquid is thus retained at the anterior part of the chest. In that case the lung is not pushed inwards towards the vertebral column, but directly towards the posterior part of the chest; you will no longer find, as in the case of other effusions, the signs of this affection posteriorly, but anteriorly; the posterior surface will offer the signs of a healthy condition*.

How great is the difficulty of the diagnosis, when the liquid is retained by false membranes at the summit of the lung, the ordinary seat of chronic hepatisation!

Sometimes the *matité* of a pleuritic effusion extends along the anterior part of the thorax as far as the precordial region. Does the *matité* of this latter region depend upon an effusion of liquid in the pleuritic cavity in the pericardium? This question is presented to us, frequently in practice. It would in general be more easily resolved, if the practitioner reflected that in order for the liquid contained in the pleuritic cavity to extend in front of the heart, it must rise posteriorly nearly as far as the spine of the shoulder blade. Convinced of this fact, whenever you observe an abnormal dulness of sound in the precordial region confound itself, on the left side, with that of a pleuritic effusion not rising above the half of the thorax, you will attribute the dulness of sound of the heart to pericarditis with effusion complicating the pleurisy.

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* *Andral, Clinique Médicale*, tom. ii. Chapter on *Pleurisy*.—*Author.*

But there is still another circumstance which can throw further light upon this question. I mean the noises of the heart, which are never so dull and distant in the case of a pleuritic effusion as in pericarditis. In fact, a pleuritic effusion scarcely ever completely covers the heart; it rather pushes it beneath the sternum, where you may hear the noises superficially.

It will still frequently be doubtful whether the dulness of sound observed in the precordial region be really owing to pericarditis or effusion in the mediastinum.

Before it was known that pericarditis had signs perceptible by auscultation, this distinction was *impossible;* at present it is only *difficult* in a great number of cases. If, when you remark a dulness of sound of this kind, you at the same time perceive distinctly and superficially the normal noises of the heart, you may be certain that it is the mediastinum which contains the liquid.

But if the effusion in the mediastinum be more considerable, if it compress and remove more deeply the centre of circulation, the *dulness* and *distance* of the noises of the heart might lead the examiner to believe in the presence of an effusion in the cavity of the pericardium. It will be still more easy to commit this mistake, if you should hear any abnormal noises during the pulsations of the heart, which, indeed, may easily happen, when, by reason of the compression of this organ by effusion in the mediastinum, its orifices become contracted*.

If there be serosity and gas in the cavity of the inflamed pleura, the gas will occupy the upper part, and you can recognise its presence by the increased clearness of sound; the lower part will be occupied by the liquid. By shaking the patient you produce a fluctuation of the liquid perceptible by the ear, a phenomenon observed by Hippocrates.

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* Article *Péricardite*, published by M. Bouillaud in the *Dictionnaire de Médecine,* in 15 volumes.—*Author.*

SECTION IV.

Tubercles.

If the tubercles be as yet very small and few in number, they present no particular sign which is perceptible by percussion or auscultation, except there be some complication of this affection, as for example, that of a chronic pneumonia.

These small bodies do not compress the parietes of the vesicles to a sufficient extent to prevent, of themselves alone, the entrance of any considerable quantity of air, and thus produce the *souffle bronchique, bronchophonie,* and dulness of sound. It is only when the tubercles acquire a considerable volume, and form large masses, that percussion and auscultation can enable us to presume their presence by the perception of the three phenomena which we have just mentioned. But this latent march of tubercles is not that which arises ordinarily.

Tubercles generally commence in consequence of bronchitis or chronic pneumonia. If it be bronchitis which produces the tubercles, the inflammation of the bronchi, either owing to the negligence of the patients, or the obstinacy of the affection, extends to the extreme ramifications of the bronchi and to the vesicles, and produces chronic hepatisation of the lungs.

These morbid phenomena may take an inverse march; thus, the affection may commence with the pulmonary parenchyma, and the inflammation of the bronchi be only consecutive.

When the malady commences by chronic hepatisation of the lungs, it is observable by means of the signs of pneumonia at the second and third stages.

The acute or chronic march of the affections is then the only difference between pneumonia and tubercles.

Whenever these signs persist during a sufficiently long time, and in addition the patient shows a predisposition to tubercles, we may presume the presence of these morbid productions.

At the same time that the tubercles are developed on one side, the opposite side presents most frequently puerile respiration.

But the tubercles do not always remain in the same condition. Their presence produces continual irritation in the parenchyma of the lungs, and in women at the epochs of menstruation, the blood, instead of going to the uterus, turns towards the lungs. In the two sexes, plethoric persons experience a more considerable congestion towards the lungs, and it is in this organ that are felt the first effects after every derangement of the circulation.

These congestions have a dangerous influence upon the march of tubercles. The chronic inflammation of the parenchyma of the lungs takes a character more acute, which facilitates the colliquation of these productions.

When the masses of tubercles are once softened, the phenomena of auscultation change.

If the substances thus softened be enclosed in the respiratory passages, they are susceptible of being displaced, and you hear during the respiration different râles, such as the *râle muqueux, sous-crépitant*, and sometimes even the real *râle crépitant*[*].

It will be the same when the tubercles occupy the cellular tissue between the vesicles. In fact, the suppuration quickly destroys the parietes of the respiratory canals, and opens a communication between them and the mass of tubercles.

The excavations are not yet sufficiently considerable to render the *son caverneux* on percussion. And as hepatisation of the lungs still constitutes at this epoch the essential element of the affection, the result most frequently is, that you find dulness of sound all round the parts where the above-mentioned râles are audible.

When the destruction of the parenchyma of the lungs continues, more considerable excavations are formed, and these are manifested by new signs.

If the cavern be in a great measure filled with liquid secreted by the inflamed parietes, the displacing of this liquid during the passage of the air, will produce *gargouillement*, or the *râle caverneux*.

If the matter be completely expectorated, you will no longer hear the *gargouillement;* but the air, passing by the cavern, will resound more loudly, and produce a

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[*] You would in this case have recourse to the observation of the rational signs of tubercles, such as the expectoration, excessive perspiration, colliquative diarrhœa, &c., in order to confirm your diagnosis. —*Translator*.

souffle, known under the name of *souffle caverneux*, or *respiration caverneuse*.

The voice of the patient resounds with considerable force in the part corresponding to the cavern, and it seems to the observer to be transmitted directly to the ear. This latter phenomenon has been known since Laennec's time, under the name of *pectoriloquie*. It is always better observed with the stethoscope than with the ear, which arises, probably, from the circumstance that the diameter of the stethoscope not exceeding that of the excavation, the abnormal vibrations of the voice are transmitted alone to the ear, and are neither confounded with nor diminished by the resonance of the voice in the adjoining parts *.

The two latter signs of auscultation, *souffle caverneux* and *pectoriloquie*, are, it is true, characteristic of a cavern in the lungs; however, hepatisation of the lungs with considerable induration of their parenchyma, may also occasion the *souffle bronchique* and *bronchophonie*, and that to so great a degree that they perfectly resemble the *souffle caverneux* and *pectoriloquie*.

Lately, I examined a patient, in whom many persons supposed that they had discovered a cavern. On examining the chest, I also thought that what I heard was the *souffle caverneux* and *pectoriloquie*. However, the absence of the *bruit de pot fêlé*, and the existence of a dulness of sound, very marked at the summit of the lung, let me to think that I had rather to do with a chronic induration, and that the supposed *souffle caverneux* and *pectoriloquie* were nothing else than the

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* For the *pectoriloquie* to be perfect, it is necessary that there should be induration around the cavern, which, indeed, is generally the case.—*Translator.*

souffle bronchique and *bronchophonie* very pronounced. The pretended *souffle caverneux* and *pectoriloquie* were some time afterwards replaced by the *râle muqueux*, the result of the colliquation of the tubercles, which further confirmed my opinion.

On percussing the region corresponding to an empty cavern, whilst the patient opens partially the mouth, you hear a particular noise, known generally under the name of *bruit de pot fêlé*.

The signs which we have enumerated are not invariable; but they change from time to time. It is thus, that the same part of the lung, which, a little before, offered the *râle caverneux*, presents afterwards, in consequence of copious expectoration, the *souffle caverneux* and *pectoriloquie*, and yields on percussion the *bruit de pot fêlé*.

If the cavern be very considerable, and occupy almost entirely a lobe of the lungs, auscultation will discover the *respiration amphorique*. If the cavern contain a certain quantity of liquid, you will frequently hear during respiration, the *tintemente métallique* of Laënnec *.

These two latter noises will be heard still more distinctly if the cavern bursts into the pleuritic cavity. Percussion will enable us to distinguish the quantity of gas and of liquid contained, in this case, in the cavity,

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* The *tintement métallique* is generally heard when the patient turns himself on the back, for example; and arises, probably, from drops of liquid falling from the upper part upon the surface of the assembled liquid.—*Translator*.

SECTION V.

Hæmoptysis.

Blood passing from the mouth may proceed from different sources; but the name of hæmoptysis has been restricted to the spitting of blood, arising from the exhalation of blood from the mucous membrane of the bronchi and the pulmonary vesicles.

The blood exhaled in the bronchi is displaced during the passage of the air, and permits us to hear the *râle muqueux*.

If the seat of hæmorrhage be in the pulmonary vesicles, or if the blood exhaled in the bronchi fall into these cavities, it most generally becomes coagulated there, and, obstructing the cavities of the vesicles, prevents the entrance of the air.

It is to this latter form of hæmorrhage that Laënnec gave the name of *apoplexie pulmonaire* ("pulmonary apoplexy").

Owing to the cavities of the vesicles being obstructed as above mentioned, we shall find, on percussion, dulness of sound, and, on auscultation, the *souffle bronchique*, and slight resonance of the voice, and the *râle muqueux* all around, owing to the liquid contained in the adjacent bronchi being displaced.

SECOND ARTICLE.

AFFECTIONS OF THE ORGANS OF CIRCULATION.

SECTION I.

Pericarditis.

PERICARDITIS is the name given to an inflammation of the pericardium. This affection was not known by our ancestors till the autopsy, and its diagnosis should be considered as an acquisition of our age.

Laënnec, that able observer, declares himself that he never could recognise the signs of this affection during life, and that if he sometimes believed it to exist, it was rather by conjecturing its presence than by arguing from determined characteristics.

More recently, M. Louis has studied the subject, and unveiled many of its mysteries.

However, the signs mentioned by this excellent observer, as characteristic of pericarditis, are far from constantly accompanying this affection.

It is only lately that Bouillaud, in France, and Latham, Stokes, and Hope, in England, have remarked some more certain signs.

If the pericardium contain no liquid, the dulness of sound of the heart will be observed nearly over its normal extent, provided that the heart do not itself augment in volume, in consequence of congestion, provoked by the inflammation of the organ which envelopes it.

In this case, the dulness of sound of the heart takes a rapid extension, and the noises of the valves are heard *distinctly* and *superficially*.

This augmentation of volume may also take place in consequence of the inflammation of the *endocarde;* and it will be somewhat difficult to recognise this latter affection from pericarditis, without effusion, attended with the same complication. Happily, the error will not have dangerous consequences; these two affections requiring nearly the same treatment.

If the pericardium contain serosity, the dulness of sound will be proportional to the quantity of liquid, and its rapid appearance will enable us to distinguish it from the dulness of sound arising from the hypertrophy of the heart.

After having examined the precordial region, and whilst the patient is lying on the back, you should accurately mark the superior and inferior limits of the liquid, and then make the patient sit up; in this position, the levels of the liquids descend more or less below the preceding points, which shows that the dulness of sound does not depend upon a simple augmentation of the volume of the heart, the result of congestion.

Can the same conclusions be drawn from the change of the lateral limits of the liquid, when the patient, after lying upon his back, turns upon one of his sides. I do not think that we can draw the same conclusions, for this change may depend on the displacing of the heart itself.

At present, auscultation possesses several sounds to enable us to detect the presence of pericarditis.

When the pericardium is the seat of a more or less considerable effusion, besides the dulness of sound yielded by percussion, auscultation will detect that the noises of the heart are *dull* and *distant*, and the finger will feel no impulsion. Sometimes, in addition to these characters, a *bruit de souffle* is audible, result of the compression of the heart and its orifices by the effusion in the pericardium.

If, without containing liquid, the pericardium be covered with false membranes, the heart, rubbing during each systole against their irregularities, will produce different noises, known under the name of *bruits de frôlement, frottement, souffle, sciè, râpe, cuir neuf*, all produced by the same mechanism, and only presenting different degrees of friction.

But the *bruit de cuir neuf*, observed for the first time by M. Collin, and which I have been able satisfactorily to verify once, is almost the only noise strictly characteristic of pericarditis. Noises, analogous to all the others heard in pericarditis, are audible in different affections of the heart itself.

However, whenever these noises are superficial and seem to pass immediately under the ear, principally during the approach of the point of the heart, we shall presume that we have to do with pericarditis.

Another distinctive character belonging to the noises of this affection, is the extent of their resonance. The noises arising from an injury of the valves or orifices of the heart, are generally heard over a considerable extent, whereas those which proceed from the pericardium are confined to the precordial region, and allow of the noises of the valves being heard below the left clavicle.

When the affection is equally acute, but the abnormal noises, instead of being *superficial*, are sufficiently *profound*, and are heard more distinctly towards the orifices of the heart, than any where else, it is very probable that they are owing to inflammation of the *endocarda*, which may have given rise to different affections of the valves and orifices of the heart, which explains the formation of the abnormal noises.

Some other circumstances may still further concur to throw additional light on the formation of the abnormal noises.

Thus, when after having heard the *souffle* when the patient was lying on the back or in an upright position, you find that it disappears when the patient lies on the right side, you will have strong reasons to believe that there exist some false membranes in the pericardium, and that the *bruit de souffle*, which depended upon the friction of these false membranes, when the point of the heart approached the parietes of the chest, has disappeared because, in the present position, it is further removed from them.

SECTION II.

Affections of the Heart.

On one hand, among the different phenomena which we have specified under the names of *bruits de souffle*, *soufflet*, *scie*, *râpe*, *&c.*, the same sign does not always belong to the same affection, and, on the other hand, several affections of the heart have nearly the same progress, and do not offer much difference in the physical signs which accompany them.

For example, we have prudently observed that hypertrophy, with dilatation of the ventricles, occasions considerable *matité* in the precordial region, and increases the shock of the heart. Is it necessary to devote a particular chapter to this affection, to say that these signs will diminish in force and extent in proportion as the heart returns to its normal condition?

Thus, then, instead of pursuing the malady step by step, and describing the successive signs, the following is the problem which we have to resolve;—An abnormal noise having been heard, to determine, both by what it may have special in itself, and by the other circumstances which accompany it, to what affection of the heart it belongs; whether it be the effect of stricture of the orifices of the heart, or of some injury of the valves, or of dilatation of the orifices and reflux of the blood from the ventricles into the auricles, or, finally, of any of the affections which we have described among the causes of the *bruits de soufflet*.

This problem is not without difficulty, and most frequently, in order to solve it, you will be obliged to proceed by way of exclusion. Quite recently, I had under my observation a young female, twenty years of age, presenting the waxen complexion peculiar to individuals affected with chlorosis. This patient had frequent palpitations of the heart and suffocations, and for some time past, swelling of the extremities of the legs towards the evening. The examination of the heart presented dulness of sound over an extent more considerable than in the normal condition; the *bruit de soufflet* was very audible during the contractions of the ventricles.

To what kind of affection were these signs owing? was it to chlorosis or to an organic affection of the orifices or valves?

The ordinary physician of the patient embraced the latter opinion, which also appeared to me at first to be beyond doubt. But afterwards the patient came under the examination of M. Bouillaud, who declared it to be chlorosis.

In fact, it is true that the symptoms observed belonged to affections of the valves or orifices of the heart; but the antecedents, such as the age and constitution of the patient, opposed this manner of thinking.

On the one hand, it is probable that in chlorosis the heart partakes the same lot as the other muscles, that it becomes attenuated, and yields easily to the efforts of the blood tending to dilate it. The auriculo-ventricular orifices will participate in this dilatation, and the blood flowing back in virtue of this disposition from the ventricles into the auricles, may easily produce the *bruit de soufflet*.

The swelling of the legs is a sign characteristic of an obstacle to the circulation, but in those affected with chlorosis, whose blood contains considerable serosity, in whom there is an exudation of this serosity through the parietes of the vessels under different forms (swelling of all the tissues, leucorrhœa), ought we to be astonished that this serosity is sometimes more perceptible in the lowest parts where it is collected by its weight?

Besides, this patient never felt any pains in the precordial region; the pulsations were extremely superficial; the abnormal noises were heard most distinctly at the base of the heart, so that there was no ground for supposing the existence of pericarditis, either with effusion or false membranes.

The constitution of the patient was a sufficient proof that the blood was poor in fibrine, so that it was not plausible to believe in the presence of coagulated blood in the cavities, which opinion was besides rejected by the march of the affection.

Thus, it is solely by way of exclusion that the diagnosis was made, and that it was decided to be chlorosis.

Consequently tonics were administered, and at present (since about a month of treatment), the *bruit de soufflet* scarcely exists.

But if the patient who presents a bruit de soufflet be in the prime of life, if he have before had rheumatism in the articulations, or felt pains in the precordial region, if he experience considerable suffocation, if the legs be swollen, &c., you will have almost certain signs of some injury of the valves of the heart, accompanied with contraction of the orifices. They will be still more certain if, instead of the *bruit de soufflet*, you hear the *bruit de râpe*.

Finally, you will recognise hypertrophy with dilatation of the ventricles, unaccompanied by any injury of the valves, when, in addition to forcible pulsations, considerable *matité* and *dulness* of the noises of the valves, you have not dropsical symptoms nor considerable dyspnœa, and if the figure be rather red than livid.

The organic affections of the heart frequently occasion consecutively a collection of serosity in the pulmonary vesicles (œdema of the lungs), effusion in the different cavities, swelling of the liver, &c. I have already mentioned the means of distinguishing the two latter complications in separate chapters.

The liquid which occasions œdema of the lungs will be displaced during each inspiration, and give rise to the *râle sous-crépitant.*

SECTION III.

Aneurism of the Aorta.

There was great uncertainty in aneurism of the aorta till Corvisart's time. Although this latter physician made useful researches on this subject, yet he declares himself that the diagnosis of aneurism always offers great obscurity, when the tumour is not evident outwardly, and the aneurism is not manifest except when the tumour projects. Both of these are false assertions, for sometimes a foreign tumour may raise the ribs, as Laënnec has observed, and propagate the pulsations of the subjacent aorta.

The majority of the signs mentioned by Corvisart as the most proper to reveal the presence of aneurism of the aorta, such as the whistling of the voice, the dulness of sound on percussion in the upper and middle parts of the sternum, the smallness and irregularity of the pulse, and its inequality in the two arms, may belong to different tumours which compress the bronchi and the arteries.

Laënnec declares that the diagnosis of aneurism of the aorta is frequently very difficult; he however sometimes detected its presence by means of the simple pulsations heard along the aorta.

The observations of M. Bouillaud have added still greater importance to this sign, which he regards as a certain sign of aneurism.

According to M. Bouillaud, "when the aneurism occupies the infra-sternal aorta, the pulsations are heard under the sternum and under the cartilages of the ribs over a more or less considerable extent, according to the volume of the tumour. The simple pulsation will become more evident in proportion as the tumour is more voluminous and is more in relation with the vibrating parts.

"The aneurisms of the descending pectoral aorta, and especially those which affect the vertebral column, will manifest their existence by simple pulsations, corresponding to the affected vertebræ, a sign so much the more certain, as, according to the observation of Laënnec, the double contractions of the heart are rarely heard in the back."

It is true that frequently the examiner may be led to mistake the pulsations heard above the sternum for the resonance of the first noise of the heart, but this pulsation differs from that of the centre of circulation by its greater intensity. It is so loud as sometimes to offend the ear, as M. Bouillaud has observed.

You will distinguish the pulsations of an aneurism of the abdominal aorta from those which result from the inflammation and spasms of this vessel, by the extent of the impulse and by the force of the noise, which is much louder in the former than in the latter case.

Percussion, giving a dull sound to a considerable extent in the region corresponding to the simple pulsations, will confirm the diagnosis made by means of auscultation, whereas alone will it never lead to a certain result.

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